ENERGY ENGINEERING ANALYSIS (EEA) PROGRAM

EUROPE

HUSTERHOEH KASERNE

PIRMASENS MILITARY COMMUNITY

VOLUME I: EXECUTIVE SUMMARY

FINAL SUBMISSION

AUGUST 1983

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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VOLUME I - EXECUTIVE SUMMARY

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1.0 INTRODUCTION

This energy study of Husterhoeh Kaserne, Primasens Military Community was authorized by the Department of the Army, Office of the Chief of Engineers as part of an Energy Engineering Analysis (EEA) Program. Overall program management rests with the Huntsville Division Corps of Engineers while contract management was performed by the Europe Division, headquartered in Frankfurt, West Germany.

This study is one of five EEA studies performed concurrently on five military communities, namely: Pirmasens; Zweibruecken; Norddeutschland; Baumholder; and Wiesbaden Military Communities. Husterhoeh Kaserne, located near the town of Pirmasens, is the only installation surveyed in the Pirmasens Military Community. The location of Husterhoeh Kaserne is shown on the vicinity map in Figure 1.1. A large number of the heated buildings are maintenance facilities, barracks, warehouses and administration type buildings, which are OMA funded facilities. In addition, there is a large housing area which is FH funded.

The functions of the non-housing type buildings are greatly diversified. There are numerous community service and support buildings, maintenance buildings for a wide variety of machinery and equipment, storage buildings for a wide variety of equipment and supplies, and communications and administration buildings. A majority of buildings are permanent masonry construction.

Utility systems primarily consist of heating plants and distribution systems, electrical supply and distribution systems, and water and sewage pump stations. In general, these systems were found to be in good condition. Central heating plants and a large number of individual heating plants are required for space heating and domestic hot water. The only coal utilized is in small manually fired anthracite boilers located in the basements of family housing.

PIRMASENS MILITARY COMMUNITY
HUSTERHOEH KASERNE

FIGURE I.1

1.1 Objective

The objectives of this Energy Study, in accordance with the "Schedule of Title I Services for Energy Engineering Analysis Program, Europe", 13 December 1980, are as follows:

a. Develop a sytsematic plan of projects that will result in the reduction of energy consumption in compliance with the objectives set forth in the Army Facilities Energy Plan, without decreasing the readiness posture of the Army.

b. Use and incorporate applicable data and results of related studies, past and current as feasible.

c. Develop coordinated basewide energy plans for each military community.

d. Prepare Program Development Brochures (PDB), DD Forms 1391, and supporting documentation for recommended ECIP projects.

e. Include in the program studies all methods of energy conservation which are practical (insofar as the state-of-the-art is reasonably firm) and economically feasible in accordance with guidance given.

f. List and prioritize all recommended energy conservation projects.

The long term objective is to implement a policy of becoming as energy self-sufficient as the state-of-the-art for energy conservation will allow within our resources and economic bounds set by the full implementation of our national energy policy as prescribed by the Army Facilities Energy Plan (dated 1 Oct 1978). See Figure 6.4

The Energy Engineering Analysis (EEA) for Husterhoeh Kaserne includes Increments A, B, G and F of Title I Services, defined as follows:

Increment A: Energy Conservation Opportunities(ECO's) which fall under the Energy Conservation Investment Program (ECIP) for buildings and processes.

Increment B: ECIP projects for utilities, energy distribution, Energy Management Control Systems (EMCS) and the use of waste fuels.

Increment G: Operation, maintenance, repair and minor construction projects for energy conservation.

Increment F: Recommendations for modifications of facilities' system operations.

Data was collected on the design and condition of the physical facilities during detailed field surveys of representative buildings. Energy consumption characteristics were defined using information furnished by the community and by field measurement and data collection. A survey program, covering all buildings, was carried out to identify ECO's in the operation and maintenance of the utility systems.

Collected data was analyzed to identify the energy conservation opportunities, which fall into the above work increments, and to predict the savings which could result from repairs and improvements. A major part of the analyses focused on comparing theoretical energy requirements of the buildings with the reported energy consumption. The BLAST computer program was used to compute heat loads for buildings,

while a custom program was developed to combine the effects of energy conversion and distribution efficiency with the theoretical heat loads and known fuel consumptions. The latter program produced the fuel distribution report for each major heating system and characterized the loads.

The energy consumption characteristics of the Husterhoeh Kaserne are typical of the installations throughout West Germany which provide a complete working and living environment for military personnel and their dependents. In contrast to many military facilities in the United States, their is no air conditioning for comfort cooling. Energy loads can be broadly classified into several groups as follows:

Thermal

- space heating
- domestic hot water
- process

Electrical

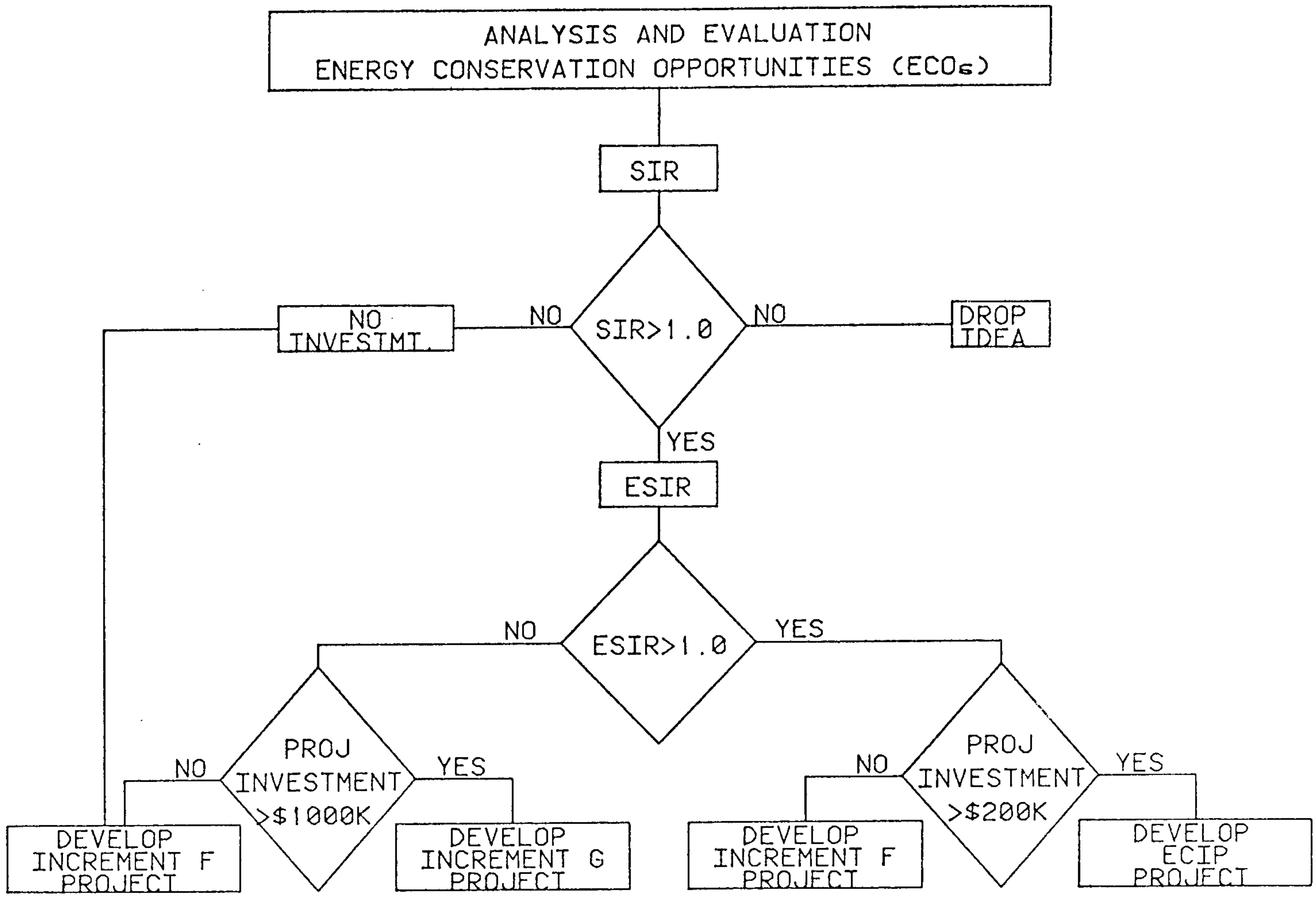
- lighting
- domestic appliances
- clothes dryers
- utility system motors
- shop and store equipment

Thermal and electrical loads peak in mid-winter and are lowest in mid-summer, as expected. Electrical loads peak during normal work day hours and follow typical patterns for a residential plus commercial community in a Northern climate. Weekend electrical load peaks are much smaller than weekday peaks, indicating that work areas are effectively shut down on weekends.

Based on the physical facilities and the energy load characteristics, ECO's were developed and analyzed for feasibility in accordance with FY 85 ECIP Guidance. Figure 1.2 shows the Project Flow Diagram indicating the economic analysis of an ECO. A systematic approach considering primary energy conversion, energy distribution, and energy utilization was employed to assure that the opportunities for energy savings would be identified. Special attention was given to state-of-the-art energy technology for conservation, management, and alternatives to the use of fossil fuels.

In cooperation with the Community, the A/E developed ECIP programming packages based upon study recommendations. DD Forms 1391 were prepared and submitted to the Community on 9 June 1983 for approval.

Detailed field survey data which served as the basis of the energy engineering analysis was previously submitted to the Pirmasens Community in a series of data report volumes. The contents of the interim submission, Volume I and II for increments A, B, and G, and the contents of the preliminary submission for increment F are combined and updated in this report.



NOTES: 1. SAVINGS TO INVESTMENT RATIO (SIR) CALCULATED AS PER NEW ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) GUIDANCE.

2. CALCULATE ENERGY SAVINGS TO INVESTMENT RATIO (ESIR) USING THE LOWER NUMBER:
(ENERGY $ SAVINGS + 0.33 ENERGY $ SAVINGS)/INVEST
(ENERGY $ SAVINGS + 0.33 ENERGY $ SAVINGS)/INVEST

2.0 EXISTING ENERGY CONSUMPTION

Energy consumption in FY 1975 is the baseline against which the reduction of energy consumption is measured. FY 1980 energy consumption data was used as a reference year for the EEA study. Energy consumption data for Husterhoeh Kaserne for both these years is shown in Table 2.1. This data was provided by Pirmasens Military Community and includes the same energy consumers as the EEA study.

To characterize the fuel consumption of Husterhoeh Kaserne, data for three fiscal years is compared. Figure 2.2 shows the quarterly consumption profile for FY 78, FY 79 and FY 80. Figure 2.3 shows the total electrical consumption of Husterhoeh Kaserne for three consecutive years; this is broken down to on-peak consumption and off-peak consumption relating to the utility's time-of-day rates. On-peak consumption ranges from approximately 875,000 kWh to 1,375,000 kWh per month and off-peak consumption ranges from 750,000 kWh to 1,100,000 kWh per month. Figure 2.4 shows the proportion of energy consumed by type of load.

The BLAST program was used to characterize the energy consumption of individual buildings. Annual fuel consumption profiles for specific buildings with typical functions and design day load profiles for representative types of buildings in Husterhoeh Kaserne are presented in Section 3, Volume II: Figures 2.5 and 2.6 are typical. The building type indicated on the design day load profile is the classification used in the Fuel Distribution Program (FDP) previously mentioned. Estimated distribution of the fuel consumption by building and load type is shown in Figures 2.7 through 2.12.

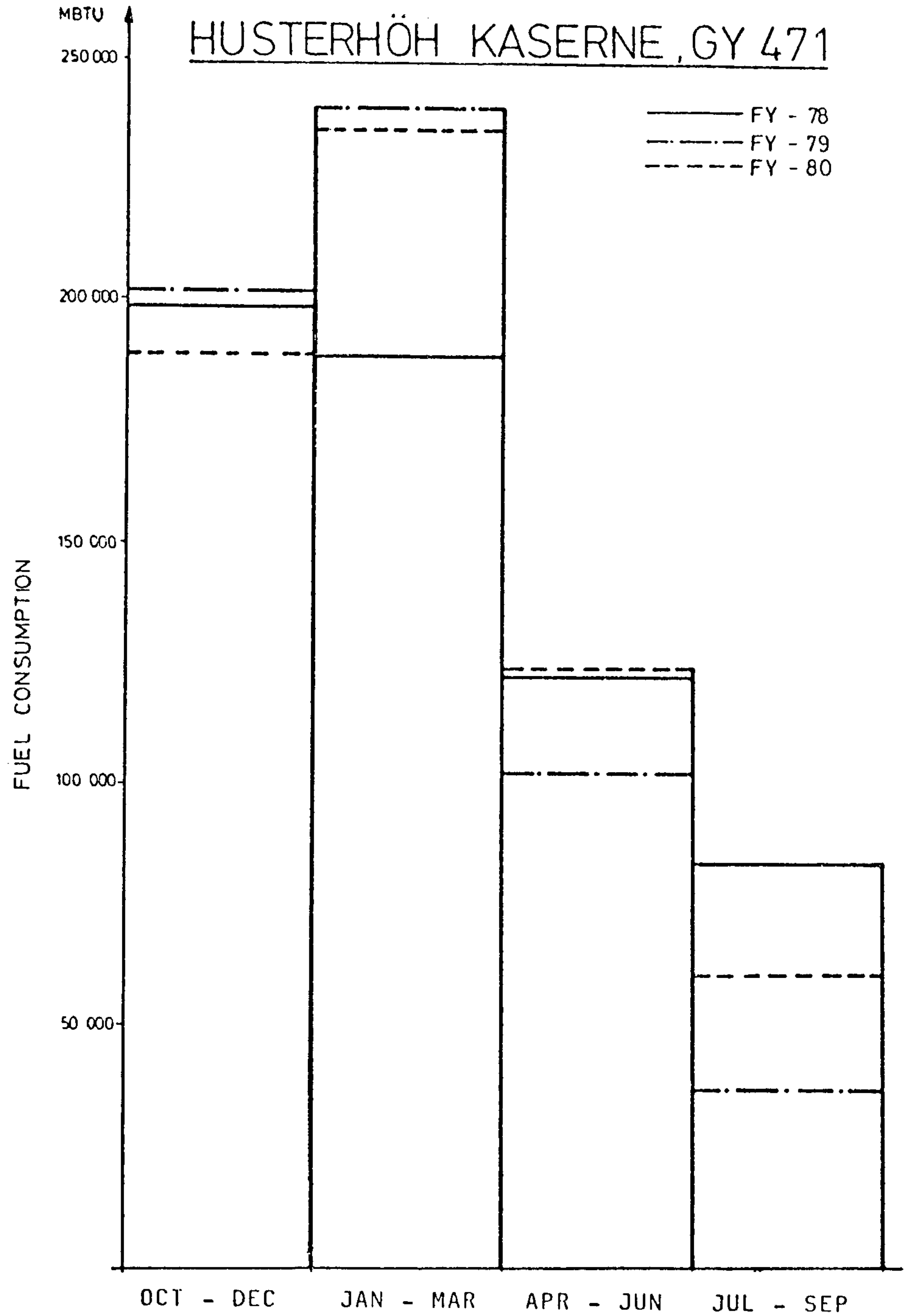
TABLE 2.1

Baseline and Reference Energy Consumption Data

(Based on 3.302×10^6 SF Occupied Area)

	F Y 1975		F Y 1980	
Fuel Type	Quantity	Consumption	Cost $/MBTU	Consumption
Anthracite Coal	5,636 Tons	143,154 MBTU*	3.38	103,200 MBTU*
Heating Oil No. 2	968,320 Gal.	134,306 MBTU*	8.45	121,364 MBTU*
Heating Oil No. 6	1,086,600 Gal.	162,652 MBTU*	5.82	155,800 MBTU*
Electric	24.56×10^6 kwh	284,900 MBTU*	4.07**	289,670 MBTU*
TOTAL (MBTU)		725,012		670,034
KBTU/sq.ft./yr.		219.57		202.9

* MBTU = 10E6 BTU
** 11,600 BTU/kWh



GRAPH OF QUARTERLY FUEL USAGE, FY 1978, 79, 80

Pirmasens Military Community

FIGURE 2.2

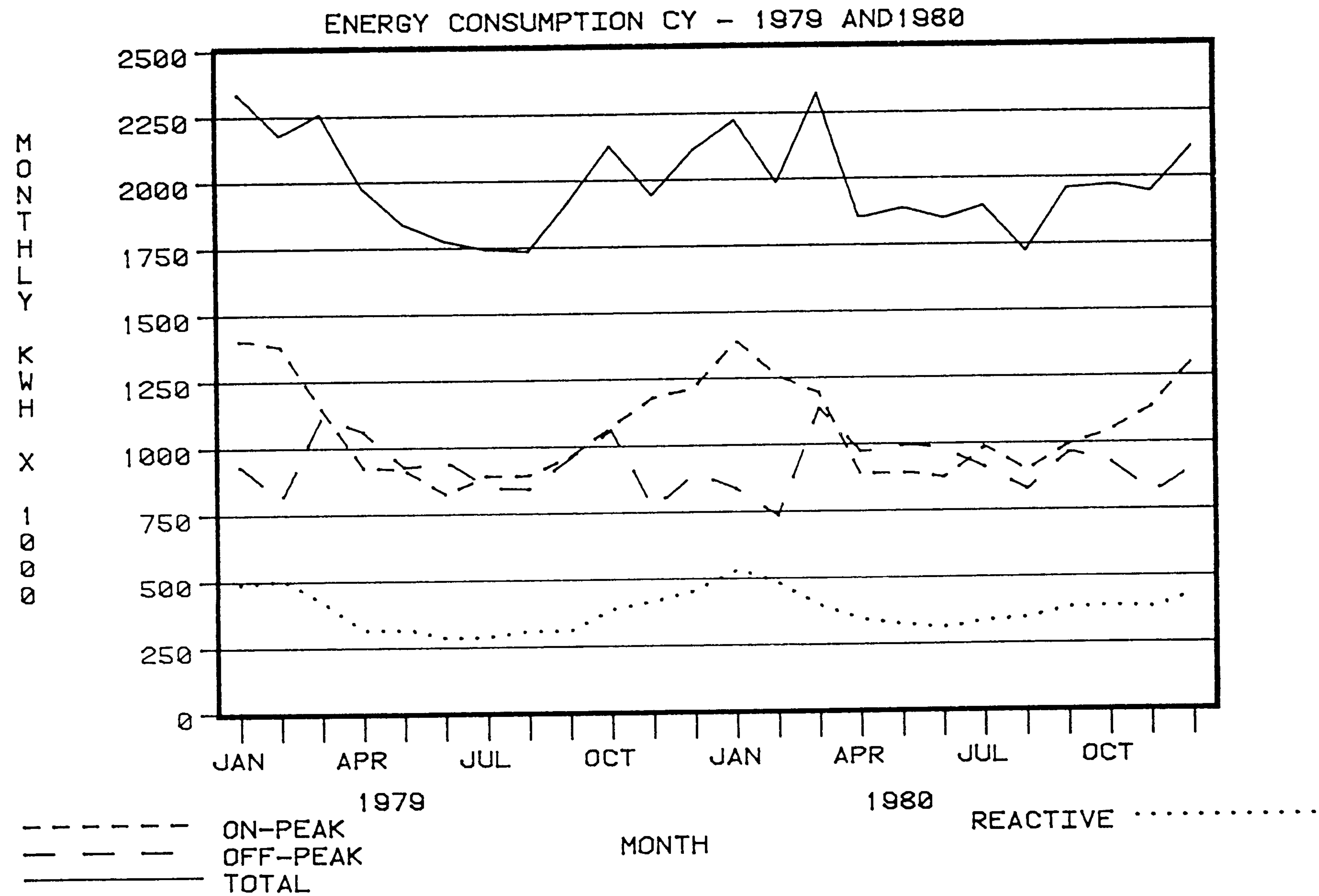
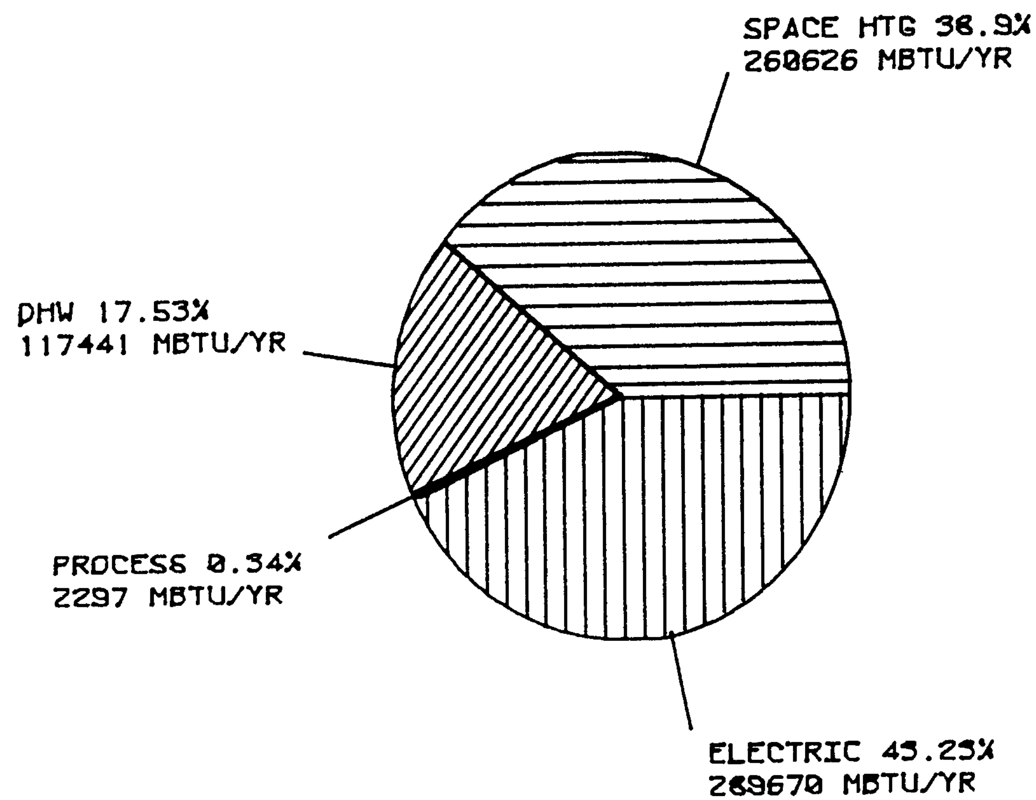

ENERGY CONSUMPTION CY - 1979 AND1980
MONTHLY KWH X 1000
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
JAN
APR
JUL
OCT
JAN
APR
JUL
OCT
1979
1980
MONTH
ON-PEAK
OFF-PEAK
TOTAL
REACTIVE

FIGURE 2.3

FIGURE 2.4

HUSTERHOEH KASERNE

PIRMASENS MILITARY COMMUNITY



TOT ENERGY CONS - 670,034 MBTU/YR (121,364 MBTU/YR #2 OIL: 166,800 MBTU/YR #6 OIL: 103,200 MBTU/YR COAL: 289,670 MBTU/YR ELEC.)

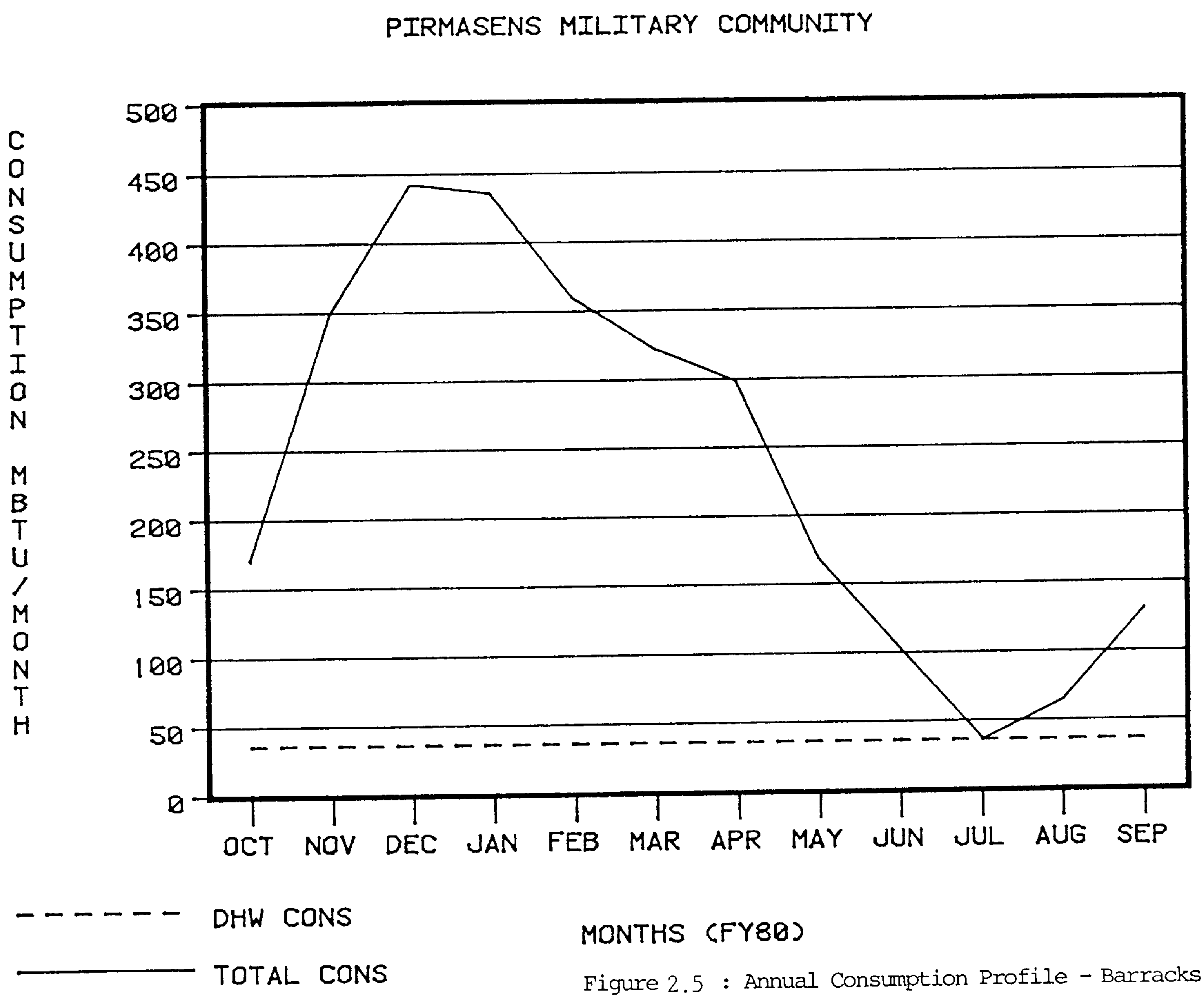


Figure 2.5 : Annual Consumption Profile - Barracks

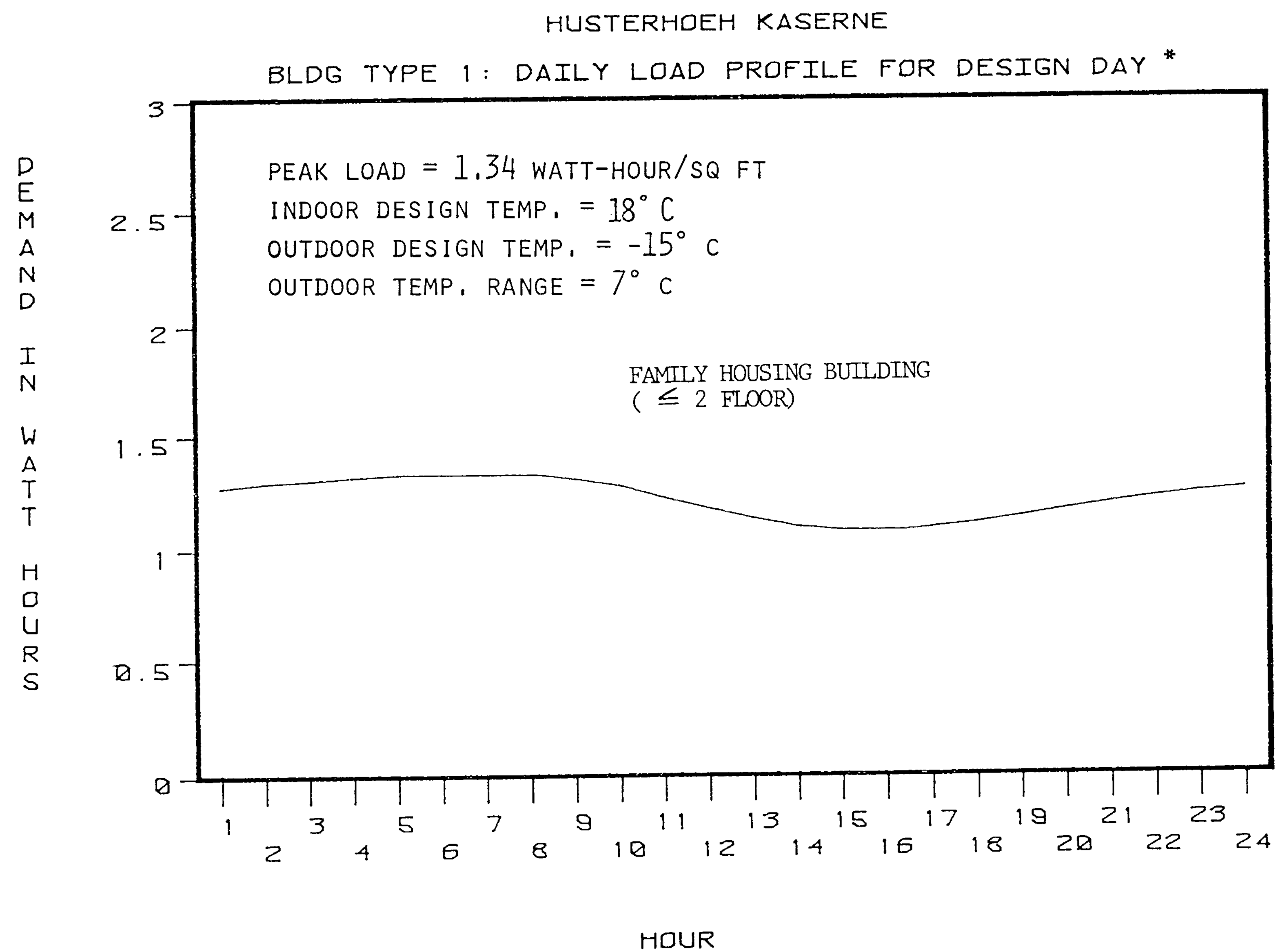


Figure 2.6

* LOAD PROFILE CALCULATED BY "BLAST"

FIGURE 2.7

BLAST WEIGHTING FACTORS 15-SEP-83 12:33:18

PIRMASENS MILITARY COMMUNITY

FUEL DISTRIBUTION

UNITS: AREA = SQUARE FEET, FUEL CONSUMPTION = MBTU/YR, LOAD = MBTU/YR

HEAT PLNT	BLDG SERV	BLDG FUNC	BLDG TYPE	TOTAL AREA	NET AREA	HEAT SYST	FUEL TYPE	FUEL CONS	EFF	SPEC LOAD	DHW LOAD	SPACE LOAD
4111												
	4101	REPAIR SHOP	11	22789	21420	HPS	OIL6	3964	0.67	0	0	2656
	4102	REPAIR SHOP	11	22789	21420	HPS	OIL6	3964	0.67	0	0	2656
	4103	REPAIR SHOP	11	22789	21420	HPS	OIL6	3964	0.67	0	0	2656
	4106	REPAIR SHOP	11	8241	7424	HPS	OIL6	1374	0.67	0	0	921
	4108	ADMNSTRTN	5	40305	34041	LTW	OIL6	5847	0.67	0	0	3917
	4109	REPAIR SHOP	11	100354	88734	HPS	OIL6	16569	0.67	0	111	11004
	4111	CNTRL HEAT	14	4743	4295	N/A	OIL6	0	0.77	0	0	0
	4122	WAREHOUSE	11	9635	8642	HPS	OIL6	1599	0.67	0	0	1072
	4123	WAREHOUSE	11	52819	50488	HPS	OIL6	9344	0.67	0	0	6261
	4125	WAREHOUSE	11	19404	17723	HPS	OIL6	3280	0.67	0	0	2198
	4133	REPAIR SHOP	11	39925	38865	LTW	OIL6	7416	0.67	0	149	4819
	4136	S & R STORE	11	58496	52420	LPS	OIL6	9850	0.67	0	99	6500
	4178	MAINT SHOP	11	12731	12086	HPS	OIL6	2237	0.67	0	0	1499
	4190	MAINT SHOP	11	11480	10374	HPS	OIL6	1920	0.67	0	0	1286
4127												
	4127	CRATE SHOP	11	10284	9960	LTW	OIL2	1250	0.71	0	0	887
4137												
	4137	LUNCH ROOM	5	4764	4304	LTW	OIL2	775	0.71	0	33	517
4141												
	4141	WAREHOUSE	11	25253	23877	LTW	OIL2	500	0.71	0	0	355
4145												
	4145	LABORATORY	5	7000	6472	LTW	OIL2	1165	0.71	0	50	777
4148												
	4148	WAREHOUSE	11	25253	23877	HPS	OIL2	475	0.71	0	0	337
4155												
	4155	PHONE XCHNG	5	17303	15939	LTW	OIL2	2869	0.71	0	122	1915
4156												
	4156	GENERATOR	12	2956	2405	LTW	OIL2	975	0.71	0	0	692
4162												
	4161	TRNSMTR STN	8	12544	11649	LTW	OIL2	1492	0.81	0	0	1209
	4162	GENERATOR	11	4741	3620	LTW	OIL2	483	0.83	0	0	401
4168												
	4168	S & R STORE	11	19618	18370	LTW	OIL2	2243	0.71	0	24	1569
4171												
	4171	WAREHOUSE	11	115579	113468	LTW	OIL2	3175	0.71	0	0	2254

FIGURE 2.8

4172	4172	WAREHOUSE	11	32073	31141	LTW	OIL2	175	0.71	0	0	124
4173	4173	WAREHOUSE	11	32073	31141	LTW	OIL2	225	0.71	0	0	160
4410	4401	SCHOOL	5	6166	4310	LTW	OIL6	686	0.70	0	29	451
	4402	ADMNSTRTN	5	6166	4310	LTW	OIL6	686	0.70	0	29	451
	4403	ADMNSTRTN	5	6166	4310	LTW	OIL6	686	0.70	0	29	451
	4404	ADMNSTRTN	5	4497	3523	LTW	OIL6	561	0.70	0	24	369
	4405	ADMNSTRTN	5	4497	3523	LTW	OIL6	561	0.70	0	24	369
	4406	ADMNSTRTN	5	6071	3922	LTW	OIL6	624	0.70	0	26	411
	4407	ADMNSTRTN	5	6071	3939	LTW	OIL6	627	0.70	0	26	413
	4408	ADMNSTRTN	5	6071	3991	LTW	OIL6	635	0.70	0	27	418
	4410	CNTRL HEAT	14	4303	3848	N/A	OIL6	0	0.77	0	0	0
	4411	BARRACKS	3	6071	3608	LTW	OIL6	962	0.70	0	226	448
	4412	BARRACKS	3	6071	3755	LTW	OIL6	1002	0.70	0	235	466
	4413	BARRACKS	3	6071	3755	LTW	OIL6	1002	0.70	0	235	466
	4414	CAFETERIA	3	5637	5012	LTW	OIL6	1201	0.70	0	219	622
	4415	ADMIN/SPPLY	5	4497	3523	LTW	OIL6	561	0.70	0	24	369
	4416	ADMIN/SPPLY	5	4500	3523	LTW	OIL6	561	0.70	0	24	369
	4417	GUEST HOUSE	1	6622	3898	LTW	OIL6	728	0.70	0	138	372
	4418	BARRACKS	3	6017	3352	LTW	OIL6	894	0.70	0	210	416
	4419	BARRACKS	3	6017	3322	LTW	OIL6	886	0.70	0	208	412
	4420	BARRACKS	3	6017	4310	LTW	OIL6	1150	0.70	0	270	535
	4421	BARRACKS	3	6017	4310	LTW	OIL6	1150	0.70	0	270	535
	4422	BARRACKS	3	6017	4310	LTW	OIL6	1150	0.70	0	270	535
	4423	ADMIN/SPPLY	5	4668	3638	LTW	OIL6	579	0.70	0	24	381
	4424	ADMIN/SPPLY	5	4497	3523	LTW	OIL6	561	0.70	0	24	369
	4425	RETAIL STR	10	5637	5012	LTW	OIL6	913	0.70	0	0	639
	4426	DISPENSARY	13	4103	2486	LTW	OIL6	700	0.70	0	181	309
	4427	BARRACKS	3	6071	3618	LTW	OIL6	965	0.70	0	226	449
	4428	BARRACKS	3	6071	4310	LTW	OIL6	1150	0.70	0	270	535
	4602	CMNTY CNTR	5	18213	12840	LTW	OIL6	2044	0.70	0	86	1345
	4604	FIRE STN	3	7961	5941	LTW	OIL6	1585	0.70	0	372	738
	4672	BOWL ALLY	10	7327	6333	LTW	OIL6	1177	0.70	0	16	808
4437	4437	REPAIR SHOP	11	2797	2523	LTW	OIL2	303	0.71	0	0	215
4462	4462	HANGER	12	6376	3497	LTW	OIL2	3000	0.71	0	0	2130
4502	4502	FAMILY HSNG.	2	29870	21604	LTW	ANTH	4753	0.59	0	729	2075
4503	4503	FAMILY HSNG	2	26563	17851	LTW	ANTH	3927	0.59	0	602	1715
4504	4504	FAMILY HSNG	2	26563	17851	LTW	ANTH	3927	0.59	0	602	1715
4505	4505	FAMILY HSNG	2	29885	21604	LTW	ANTH	4753	0.59	0	729	2075
4506	4506	FAMILY HSNG	2	29885	21604	LTW	ANTH	4753	0.59	0	729	2075

FIGURE 2.9

4507	4507	FAMILY HSNG	2	29885	21604	LTW	ANTH	4753	0.59	0	729	2075
4508	4508	FAMILY HSNG	2	43074	31294	LTW	ANTH	6885	0.59	0	1056	3006
4509	4509	FAMILY HSNG	2	43074	31294	LTW	ANTH	6885	0.59	0	1056	3006
4510	4510	FAMILY HSNG	2	43074	31294	LTW	ANTH	6885	0.59	0	1056	3006
4511	4511	FAMILY HSNG	2	42126	30416	LTW	ANTH	0	0.59	0	0	0
	4512	FAMILY HSNG	2	42126	30416	LTW	ANTH	0	0.53	0	0	0
4513	4513	FAMILY HSNG	2	28912	20566	LTW	ANTH	4525	0.59	0	694	1975
4514	4514	FAMILY HSNG	2	28912	20566	LTW	ANTH	4525	0.59	0	694	1975
4515	4515	FAMILY HSNG	2	29870	21604	LTW	ANTH	4753	0.59	0	729	2075
4516	4516	FAMILY HSNG	2	26563	17851	LTW	ANTH	3927	0.59	0	602	1715
4517	4517	FAMILY HSNG	2	42126	30416	LTW	ANTH	6692	0.59	0	1026	2922
4518	4518	FAMILY HSNG	2	42126	30416	LTW	ANTH	6692	0.59	0	1026	2922
4519	4519	FAMILY HSNG	2	26702	17851	LTW	ANTH	3927	0.59	0	602	1715
4520	4520	FAMILY HSNG	2	26702	17851	LTW	ANTH	3927	0.63	0	643	1831
4525	4525	COMMISSARY	11	53745	40800	LTW	OIL2	4521	0.76	0	69	3367
4527	4527	FAMILY HSNG	2	36032	24101	LTW	ANTH	5302	0.59	0	813	2315
4528	4528	SCHOOL	5	70365	46239	LTW	OIL2	9350	0.72	0	471	6261
4529	4529	FAMILY HSNG	2	37157	23072	LTW	ANTH	5076	0.59	0	779	2216
4530	4530	FAMILY HSNG	2	36032	24101	LTW	ANTH	5302	0.68	0	937	2668
4531	4531	FAMILY HSNG	2	36032	24101	LTW	ANTH	5302	0.59	0	813	2315

FIGURE 2.10

4532	4532	THEATRE	10	11173	9372	LTW	OIL2	1100	0.81	0	53	838
4537	4537	BARRACKS	4	31126	22291	LTW	OIL2	2800	0.72	0	383	1633
4535	4535	FAMILY HSNG	1	12256	9703	LPS	OIL2	2495	0.62	0	418	1129
	4536	GUEST HOUSE	1	12256	9703	LTW	OIL2	2249	0.62	0	265	1129
	4538	OFFICER CLB	10	11160	7590	LPS	OIL2	1981	0.71	0	225	1181
4540	4540	POST CHAPEL	10	10345	8399	LPS	OIL2	1764	0.81	0	0	1429
4544	4544	YOUTH CNTR	5	6361	4346	LPS	OIL2	1175	0.66	0	47	729
4545	4545	KNDRGRTN	10	11214	9406	LTW	OIL2	1976	0.72	0	85	1337
4546	4546	NCO CLUB	5	11272	8248	LPS	OIL2	1750	0.78	0	232	1133
4548	4548	CLUB HOUSE	5	8981	6402	LTW	OIL2	1075	0.73	0	126	659
4600	4600	SCHOOL	8	13263	9496	LTW	OIL2	1100	0.71	0	0	781
4601	4601	LAUNDRY	5	3529	3161	LTW	OIL2	2963	0.74	1700	0	493
4603	4603	ADMNSTRTN	5	3271	1639	LTW	OIL2	295	0.71	0	13	197
4606	4606	BARRACKS	4	59900	21421	LTW	OIL2	4812	0.75	0	1443	2165
	4607	BARRACKS	4	59900	20052	LTW	OIL2	5118	0.66	0	1351	2027
	4608	BARRACKS	4	59900	20209	LTW	OIL2	5158	0.66	0	1362	2043
	4609	BARRACKS	4	59900	20125	LTW	OIL2	5137	0.66	0	1356	2034
4611	4611	MESSHALL	5	32616	20066	LTW	OIL2	4349	0.75	0	1174	2088
	4612	LIBRARY	8	15803	11834	LTW	OIL2	1976	0.67	0	79	1244
4614	4614	MESSHALL	2	32936	20298	LPS	OIL2	4971	0.77	0	689	3139
4617	4613	BARRACKS	4	160628	62002	LTW	OIL2	11105	0.68	0	3021	4531
	4616	ADMNSTRTN	6	60600	45450	LTW	OIL2	3974	0.68	0	216	2486
	4617	ADMNSTRTN	6	60600	31233	LTW	OIL2	2443	0.76	0	149	1708
	4618	BARRACKS	4	59900	36098	LTW	OIL2	6466	0.68	0	1759	2638
	4619	ADMNSTRTN	6	61543	28500	LTW	OIL2	2492	0.68	0	136	1557
4624	4624	CMNTY CNTR	6	34342	26372	LTW	OIL2	2362	0.78	0	147	1695

FIGURE 2.11

4625												
	4625	WAREHOUSE	11	19404	17723	LTW	OIL2	2100	0.71	0	0	1491
4644												
	4560	FAMILY HSNG	2	21941	13969	LTW	OIL6	3016	0.73	0	573	1629
	4561	FAMILY HSNG	2	21941	13969	LTW	OIL6	3016	0.73	0	573	1629
	4562	FAMILY HSNG	2	21941	13969	LTW	OIL6	3016	0.73	0	573	1629
	4563	FAMILY HSNG	2	21941	13969	LTW	OIL6	3016	0.73	0	573	1629
	4564	FAMILY HSNG	1	5127	4304	LTW	OIL6	911	0.73	0	180	485
	4565	FAMILY HSNG	1	10295	7184	LTW	OIL6	1520	0.73	0	300	810
	4566	FAMILY HSNG	1	5127	4304	LTW	OIL6	911	0.73	0	180	485
	4567	FAMILY HSNG	1	10295	7184	LTW	OIL6	1520	0.73	0	300	810
	4568	FAMILY HSNG	1	5127	4304	LTW	OIL6	911	0.73	0	180	485
	4570	FAMILY HSNG	7	3078	2478	LTW	OIL6	547	0.73	0	102	298
	4572	FAMILY HSNG	1	5127	4304	LTW	OIL6	911	0.73	0	180	485
	4573	FAMILY HSNG	1	10295	7184	LTW	OIL6	1520	0.73	0	300	810
	4574	FAMILY HSNG	1	10295	7184	LTW	OIL6	1520	0.73	0	300	810
	4575	FAMILY HSNG	2	21941	13969	LTW	OIL6	3016	0.73	0	573	1629
	4576	FAMILY HSNG	1	10295	7184	LTW	OIL6	1520	0.73	0	300	810
	4578	FAMILY HSNG	1	10295	7184	LTW	OIL6	1520	0.73	0	300	810
	4628	MAINT SHOP	12	14136	12133	LTW	OIL6	4436	0.73	0	0	3239
	4629	MAINT SHOP	12	3068	2274	LTW	OIL6	831	0.73	0	0	607
	4634	PO MAIN	8	8982	6458	LTW	OIL6	1107	0.73	0	0	808
	4638	WAREHOUSE	12	11912	10627	LTW	OIL6	3886	0.73	0	0	2637
	4639	REPAIR SHOP	11	5900	5278	LTW	OIL6	965	0.73	0	0	704
	4644	CNTRL HEAT	14	3822	3413	N/A	OIL6	0	0.80	0	0	0
	4646	ADMNSTRTN	5	36723	25762	LTW	OIL6	4371	0.73	0	0	3191
	4647	REPAIR SHOP	11	10028	9168	LTW	OIL6	1676	0.73	0	0	1224
	4648	REPAIR SHOP	12	10302	9590	LTW	OIL6	3507	0.73	0	0	2560
	4649	REPAIR SHOP	12	7896	6760	LTW	OIL6	2472	0.73	0	0	1804
	4654	REPAIR SHOP	12	7730	6822	LTW	OIL6	2494	0.73	0	0	1821
	4655	ADMNSTRTN	5	4060	3550	LTW	OIL6	641	0.73	0	28	440
	4656	MAINT SHOP	11	10983	8492	LTW	OIL6	1553	0.73	0	0	1133
	4657	WAREHOUSE	12	11020	10688	LTW	OIL6	3908	0.73	0	0	2853
	4658	MAINT SHOP	12	1970	1827	LTW	OIL6	668	0.73	0	0	488
	4664A	WTR TRTMNT	12	4634	3783	LTW	OIL6	1383	0.73	0	0	1010
	4666	MAINT SHOP	12	3174	2238	LTW	OIL6	818	0.73	0	0	597
	4667	ADMNSTRTN	5	6146	5710	LTW	OIL6	1031	0.73	0	45	707
	4668	MAINT SHOP	11	3920	3597	LTW	OIL6	658	0.73	0	0	480
4669												
	4669	ADMNSTRTN	5	10167	9856	LTW	OIL2	1774	0.71	0	76	1184
4673												
	4673	GYM/THEATRE	10	26305	18073	LPS	OIL2	4600	0.71	0	425	2841

UNHEATED BUILDINGS

BUILDING NUMBER	BUILDING FUNCTION
4118	SUBSTATION
4120	GENERAL PURPOSE WAREHOUSE
4121	GENERAL PURPOSE WAREHOUSE
4126	GENERAL PURPOSE WAREHOUSE
4128	HUMIDITY CONTROLLED WAREHOUSE

FIGURE 2.12

4129	HUMIDITY CONTROLLED WAREHOUSE
4130	SUBSTATION
4131	HUMIDITY CONTROLLED WAREHOUSE
4134A	HUMIDITY CONTROLLED WAREHOUSE
4134B	HUMIDITY CONTROLLED WAREHOUSE
4134C	HUMIDITY CONTROLLED WAREHOUSE
4134D	HUMIDITY CONTROLLED WAREHOUSE
4134E	HUMIDITY CONTROLLED WAREHOUSE
4134F	HUMIDITY CONTROLLED WAREHOUSE
4134G	HUMIDITY CONTROLLED WAREHOUSE
4134H	HUMIDITY CONTROLLED WAREHOUSE
4134I	HUMIDITY CONTROLLED WAREHOUSE
4134J	HUMIDITY CONTROLLED WAREHOUSE
4132	HUMIDITY CONTROLLED WAREHOUSE
4138	SUBSTATION
4140	HUMIDITY CONTROLLED WAREHOUSE
4141	HUMIDITY CONTROLLED WAREHOUSE
4142	HUMIDITY CONTROLLED WAREHOUSE
4143	HUMIDITY CONTROLLED WAREHOUSE
4144	HUMIDITY CONTROLLED WAREHOUSE
4146	HUMIDITY CONTROLLED WAREHOUSE
4147	HUMIDITY CONTROLLED WAREHOUSE
4148	HUMIDITY CONTROLLED WAREHOUSE
4149	HUMIDITY CONTROLLED WAREHOUSE
4152	HUMIDITY CONTROLLED WAREHOUSE
4163	SUBSTATION
4165	HUMIDITY CONTROLLED WAREHOUSE
4173	HUMIDITY CONTROLLED WAREHOUSE
4174	HUMIDITY CONTROLLED WAREHOUSE
4175	SUBSTATION
4179	SUBSTATION
4409	SUBSTATION
4521	SUBSTATION
4522	SUBSTATION
4523	SUBSTATION
4526	SUBSTATION
4543	SEWAGE PUMP STATION
4571	SUBSTATION
4605	SUBSTATION
4626	SUBSTATION
4637	SUBSTATION
4643	SUBSTATION
4657	SUBSTATION
4664D	WATER PUMP STATION
4699	SEWAGE TREATMENT PLANT

3.0 ENERGY CONSERVATION OPPORTUNITIES DEVELOPED

As described under the Methodology Section, Volume II: Study Report, based upon record data provided by the community, detailed site surveys and discussions with Facilities Engineering personnel, all practical energy conservation measures were technically and economically evaluated to determine if they met ECIP criteria. The "Energy Conservation Options" listing for Climate Zone 3 (3000 - 6000 degree days) in Annex E of the Army Facilities Energy Plan was used as a starting list of possible conservation measures; this list, modified to be applicable to installations in West Germany, is presented in Section 4, Volume IV: Appendix. Recommended modifications which were not on the list include the installation of fans to prevent hot air stratification, installation of thermal barriers for windows in intermittently occupied buildings, installation of domestic hot water heat pumps and installation of turbulators in firetube boilers.

Based upon recommendations made by the A/E in the Interim Submittal and agreements reached with the community, recommended ECIP projects were packaged and project documents developed for ECIP funding in accordance with FY 85 criteria. Those energy conservation measures are described hereafter; ECO numbers and titles correspond to those presented in Section 4 of Volume II.

ECO No. 41112: Vestibule

By constructing a new exterior door and passageway in front of an existing exterior door the infiltration of outside air into a building is significantly reduced. Vestibules are cost effective at door locations which are frequently used.

ECO No. 41121: Roof Insulation

Heat load analysis leads to the recommendation of roof insulation for many buildings. Building roofs generally have higher heat loss and lower insulation cost per square foot than walls. The best type of insulation is determined by the configuration and the utilization of the attic space.

ECO No. 41141: Double Glazed Windows

A significant portion of energy loss through a building envelope is due to windows. Heat Losses occur due to both conduction of heat through the glass and infiltration of outside air through window perimeter cracks. Where infiltration heat losses are excessive due to poor fitting windows, new double glazed tight fitting windows are recommended. Although weatherstripping can also reduce infiltration through windows, the life of the weatherstripping is very limited compared to carefully installed windows.

ECO No. 41151: Mess Hall Exhaust Air Heat Recovery

Ventilation standards for mess halls require a minimum of ten air changes per hour. Heat recovery units can be installed to preheat the intake air using the warm exhaust air and thus reduce heating fuel consumption. Where the ventilation systems are designed and operated to achieve the standard ventilation rates, heat recovery systems are cost effective.

ECO No. 41161: Laundry Exhaust Air Heat Recovery

Air which is used to dry clothes in a laundry is heated from a temperature of 70°F up to a temperature of 230°F. This hot air removes moisture from the clothes and is vented to atmosphere, carrying off a large amount of energy. Where the dryer capacity is sufficient and the hours of operation are high enough it becomes economical to recover a portion of this heat.

ECO No. 41211: Lighting System Replacement

The development of high efficiency lighting systems created opportunities for reducing the energy for lighting without reducing the illumination. In many lighting systems this can be accomplished by simply replacing the lamp. Slight modifications to existing fixtures are required for some conversions to high efficiency lamps.

ECO No. 42111: Thermostatic Radiator Valves

Thermostatic radiator valves regulate indoor temperature by controlling the heating fluid supply to radiators. Thermostatic radiator valves reduce localized overheating by compensating for interior and exterior heat gains other than the heating system and limit the maximum heat supply to a radiator.

ECO No. 42112: Building LTW Controls

Building temperature control systems are installed to adjust the heating water supply temperature to the radiators in a building. Overheating of buildings is reduced by regulating the supply temperature in response to weather conditions, and by improving heat distribution where buildings are part of a network.

ECO No. 42121: Prevent Air Stratification

In large open areas with high ceilings, warm air rises creating a temperature differential between the floor and ceiling. If room air is vertically mixed, such as by ceiling fans, the air temperature stratification is reduced. A more uniform temperature results in less heat to maintain minimum temperature at the occupied floor level and less heat loss through the roof.

ECO No. 43111: Install Flue Gas Dampers

Burners in small oil and gas fired boilers are typically controlled by on-off or stepped firing rates. Natural draft of the flue gas exhaust continues to draw air through the boiler during burner shutoff resulting in the exhaust of heated air. Automatic dampers installed in the flue gas duct close when the burners are off, thereby eliminating unnecessary heat losses through the stack.

ECO No. 43121: Install Heat Pump to Supplement DHW Generation

Small, electric heat pumps, of 750 watts or more, can be tied into existing hot water generation equipment in order to supply a portion of the total energy requirements. This can either be purchased as one complete unit for new installations, or can be added to an existing system.

ECO No. 43131: Install Turbulators in Firetube Boilers

Overall efficiency of firetube boilers can be improved by the installation of turbulators in the steam generating tubes. Turbulators are deformed strips of steel which are inserted directly into the boiler firetubes to improve heat transfer by increasing the turbulence while reducing the velocity of gasses passing through the tubes. Turbulators can be installed with only minor adjustments to the burners and boiler controls.

ECO No. 43132: Install Boiler Combustion Controls

Where annual plant loading is sufficient and the plant efficiency is low, an O_2 trim system which monitors unburned combustilbles can be justified. This type of control will optimize combustion regardless of boiler type, operators experience or even fuel type.

The following projects were developed, even though they do not meet ECIP criteria, because they will serve to reduce dependence on critical fuels; however, they will also increase the total fuel consumption. For ECO No. 43133, the Savings-to-Investment Ratios (SIR) are greater than 1.0 but the Energy Savings-to-Investment Ratios are less than 1.0; for ECO No. 43122 the SIR is less than 1.0.

- ECO No. 43133: Conversion of Oil-Fired Central Heating Plants to Automatic Coal-Firing.

- ECO No. 43122: Conversion of Electric Domestic Hot Water Generators to Indirect DHW generators utilizing the heating medium.

Specific Operations and Maintenance Modifications were identified as follows:

- Load Shedding
- Repair Vent Dampers and Seal Miscellaneous Openings in Building Envelopes
- Reset Existing Heating System Controls and Thermostatic Valves
- Insulate Valves in Heating Plant
- Reduce Domestic Hot Water Temperature
- Repair of Leaks in the Hot Water and Steam Distribution Systems
- Insulate Hot Pipelines
- Reduce Heating in Unoccupied Areas
- Installation of Timers on Vending Machines
- Reduction of Lighting by Lamp Removal
- Install Additional Light Switches
- Add Timers to Light Switches
- Add Outdoor Light Controls

General Operations and Maintenance Recommendations were made as follows:

- o Night Temperature Setback
- o Domestic Hot Water Flow Control
- o Optimize Transformer Loading

In addition to the above listed projects, developed to improve the efficiency of energy conversion, distribution and utilization, policy changes are recommended which can reduce energy consumption and/or operating costs:

- o Improve communications between the users and the office of the facility engineer by means of an energy conservation coordinator of each installation and a monitor for each energy consuming building. The energy usage for each building should be recorded and discussed at regular meetings where policy for energy conservation performance can be evaluated.

- o Educate the building occupants to minimize the use of lighting, domestic hot water and heat. All family housing lighting and some hot water heaters in individual dwelling units are controlled by building occupants. Although building controls and thermostatic valves can reduce overheating, windows and doors left open in the heating season cannot be eliminated by controls.

- o Negotiate for reducing the cost of purchased electricity. Since utility rates are designed for an entire class of customers, a fair but more attractive rate may be considered negotiable for a specific load profile. Investigate the consolidation of electrical services which are billed under different rate schedules to achieve a more favorable rate structure.

- Institute procedures to assure that energy savings are considered in all new projects which are specified. When specific goals and guidelines are adopted, the facilities should be upgraded in a uniform manner with each repair or new construction project. All projects should be reviewed by the community energy coordinator to assure that these projects are consistent with energy plan goals.

- Specify energy conservation options for replacement equipment as follows:

  - high efficiency motors
  - high efficiency air conditioning units
  - automatic shut off controls for clothes dryers
  - improved insulation and other design features for domestic food refrigerators

4.0 ENERGY AND COST SAVINGS

Basewide energy consumption after implementation of the EEAP Energy Plan is projected to be 543,923 MBTU/yr; this is a 25% reduction in fuel consumption as compared to FY 75 energy consumption of 725,012 MBTU/yr.

The projected savings are allocated by fuel type as follows:

	ANNUAL CONSUMPTION (MBTU/yr)			SAVINGS
	FY 75	FY 80	6,587 FY 86	MBTU/YR
Electric :	284,900	289,670	283,083	1,817
No. 6 Oil :	162,652	155,800	111,983	50,669
No. 2 Oil :	134,306	121,364	79,907	54,399
Coal :	143,154	103,200	68,950	74,204
			TOTAL SAVINGS =	181,089

In constant FY 80 dollars, the cost of Husterhoeh Kaserne's energy is projected to be $2,712,154 as compared to $3,724,924 : a savings of $1,012,770 per year in 1980 dollars.

4.1 ECIP Projects

Project documents have been prepared for energy conservation measures which qualify for ECIP funding. Volume III of the report contains completed DD Forms 1391 and Project Development Brochures for these projects. ECIP projects are summarized in Table 4.1.

The implementation of the energy conservation measures developed for ECIP funding will require an investment of $1,769,150 and result in an annual savings of 68,016 MBTU/yr. Assuming a discount rate of 10%, the discounted payback for the total investment would be 3.6 years.

Table 4.1

SUMMARY OF RECOMMENDED ECIP PROJECTS

Project Description	Energy Saved (MBTU/YR)	Energy Saved ($/YR)	Total Investment ($)	ESIR
ECIP Weatherization (OMA Facilities) . Install Vestibules . Install Roof Insulation . Install Double Glazed Windows	9,330	70,241	271,350	3.1
ECIP Energy Conservation Improvements (OMA Facilities) . Install Flue Gas Dampers . Install DHW Heat Pumps . Install Turbulators . Install Combustion Controls . Replacement of Lighting Systems	22,201	141,397	567,200	3.0
ECIP Family Housing Energy Conservation Improvements . Install Roof Insulation . Install Thermostatic Radiator Valves	27,162	96,744	520,400	2.8
ECIP Facilities Energy Improvements (OMA Facilities) . Install Thermostatic Radiator Valves . Install Building LTW Controls . Prevent Air Stratification	5,336	35,548	200,700	2.2
ECIP Heat Recovery Systems (OMA Facilities) . Install Messhall Heat Recovery System . Install Laundry Heat Recovery System	3,987	32,796	209,500	1.8

4.2 Specific Operation and Maintenance Modifications

Recommendations for modification of the operation and maintenance of utility systems were developed from building operations survey data as part of Increment F of this study. These energy conservation measures are expected to save 22,680 MBTU/yr for a total investment of $16,164: at an estimated savings of $155,000/yr the investment will payback in less than 2 months. See Table 4.2. A listing of Increment F Projects, ranked by ESIR, is included as Exhibit A at the end of this volume.

4.3 General Operation and Maintenance Modifications

General opportunities for conservation in the operation and maintenance of utilities systems which have been recommended are summarized below:

PROJECT DESCRIPTION	ENERGY SAVINGS (MBTU/yr)	MATERIAL COST ($)	LABOR HOURS (HOURS)
Night Temperature Setback	26,015	-	60
Domestic Hot Water Flow Control	9,400	6,500	280

Night Temperature Setback

The energy savings attainable through night and weekend temperature setback of intermittently occupied buildings was not applied to the ECIP projects for building heating system controls.

After the controls are installed, setback of indoor temperature during unoccupied periods can be implemented for additional heating energy savings.

Domestic Hot Water Flow Control

Where flow rates through shower heads and faucets are excessive, flow control devices are being installed to limit energy consumption.

Table 4.2

SPECIFIC OPERATIONS AND MAINTENANCE MODIFICATIONS

Project Description	Implementation Costs (Materials) $	Implementation Costs (Man-hours)	Estimated Energy Savings (MBTU/YR)
Repair & Install Vent Dampers	750	40	120
Repair Broken Windows	80	10	5
Reset Building Heating Controls	0	124	8,478
Reduce Domestic Hot Water Temps.	5,700	324	12,695
Insulate Valves	5,330	50	154
Reduce Domestic Hot Water Flow	60	6	45
Repair Steam & Hot Water Leaks	50	10	229
Insulate Hot Pipelines	900	16	510
Replace, Reset Thermostatic Valves	1,160	72	56
Install Timer on Vending Machine	30	2	8
Removal of Light Shades or Diffuses	0	234	88
Reduction of Lighting by Lamp Removal	0	43	39
Add Light Switches	600	68	51
Timers on Light Switches	1,440	150	194
Install Outdoor Light Photocell	64	4	8
Repair Roof Leaks on Humidity Controlled Warehouse	-	-	-
Interlock Space Heaters to Vehicle Doors for Maintenance Shops	-	-	-

4.4 Recommendations for Electrical Load Management

Management of electrical loads creates opportunities for reducing operating costs. The methods recommended do not conserve a significant amount of energy but rather control the use of electrical energy in order to take fair advantage of utility rate schedules. The recommendations are summarized below.

	Cost Savings ($/yr)	Investment ($)
1. Load Shedding	$21,137	126,200

A demand limiting (ripple) control system can be installed to reduce peak demand utility charges by temporarily disconnecting certain loads during peak demand periods.

2. Use of Standby Generators

If 50% of the presently installed standby generators were operated parallel with the utility for approximately four hours each day in January to lower the annual peak demand, the rate paid for electrical energy throughout the year would be lowered. If policy could be changed to permit the use of generators in this manner, annual savings would be estimated as follows:

400 kW Generator. - assuming a 100 kW
Demand Reduction : $10,080

	Cost Savings ($/yr)	Investment ($)
3. Power Factor Correction Husterhoeh Kaserne consistently operates at a high power factor; hence, there are no savings possible by the addition PF correction devices.	-	-
4. Optimum Transformer Loading Transformer losses can be reduced by maintaining transformer loading in the most economical loading range.	2,900	
TOTAL	$34,117/yr	

4.5 Summary of Energy and Cost Savings

Potential energy and utility cost savings for Husterhoeh Kaserne are summarized below.

	Energy Savings (MBTU/yr)	Cost Savings ($/yr)
ECIP Projects	68,016	$376,726
Specific Operation and Maintenance Recommendations	22,680	155,000
General Operation and Maintenance Recommendations	35,415	-
Recommendations for Load Shedding and Power Factor Correction	-	21,137
Optimum Transformer Loading	-	2,900
	TOTAL	$555,763

INCREMENT F

OPERATION AND MAINTENANCE ECO SUMMARY

BLDG	CONSERVATION OPTION	MBTU/YR	$/YR	TOTAL COST	ESIR	SIR	MANHOURS	L.T.	REF.
4613	Reduce DHW Temperature	1,644	13,890	12	14,357.0	14,357.0	1	1	04
4410	Reduce DHW Temperature	1,257	7,317	12	8,847.4	8,847.4	1	1	04
4609	Reduce DHW Temperature	719	6,076	24	3,140.3	3,140.3	2	1	04
4109	Reset Heat Controls	1,452	8,452	49	2,555.1	2,555.1	4	1	02
4528	Reduce DHW Temperature	196	1,658	12	1,714.1	1,714.1	1	1	04
4136	Reset Heat Controls	844	4,912	49	1,485.0	1,485.0	4	1	02
4546	Reduce DHW Temperature	164	1,382	12	1,428.8	1,428.8	1	1	04
4133	Reset Heat Controls	626	3,642	49	1,101.0	1,101.0	4	1	02
4614	Reset Heat Controls	355	2,997	49	774.4	774.4	4	1	02
4629	Reset Heat Controls	386	2,247	49	679.2	679.2	4	1	02
4657	Reset Heat Controls	340	1,979	49	598.2	598.2	4	1	02
4638	Reset Heat Controls	338	1,968	49	594.9	594.9	4	1	02
4564	Reduce DHW Temperature	79	459	12	555.3	555.3	1	1	04
4648	Reset Heat Controls	305	1,776	49	536.8	536.8	4	1	02
4568	Reduce DHW Temperature	72	416	12	503.2	503.2	1	1	04
4414	Reset Heat Controls	271	1,575	49	476.0	476.0	4	1	02
4528	Reset Heat Controls	757	6,393	195	413.0	413.0	16	1	02
4527	Reset Heat Controls	341	1,154	49	403.9	403.9	4	1	02
4531	Reset Heat Controls	341	1,154	49	403.9	403.9	4	1	02
4530	Reset Heat Controls	341	1,154	49	403.9	403.9	4	1	02
4545	Reset Heat Controls	162	1,365	49	352.8	352.8	4	1	02
4136	Repair Steam Leaks	196	1,141	49	345.1	345.1	4	1	06
4560	Reset Heat Controls	194	1,130	49	341.6	341.6	4	1	02
4561	Reset Heat Controls	194	1,130	49	341.6	341.6	4	1	02
4562	Reset Heat Controls	194	1,130	49	341.6	341.6	4	1	02
4563	Reset Heat Controls	194	1,130	49	341.6	341.6	4	1	02
4669	Reset Heat Controls	145	1,226	49	316.8	316.8	4	1	02
4136	Reduce DHW Temperature	43	249	12	301.6	301.6	1	1	04
4638	Reduce DHW Temperature	71	290	12	290.9	290.9	1	1	36
4566	Reduce DHW Temperature	79	459	24	277.7	277.7	2	1	04
4572	Reduce DHW Temperature	79	459	24	277.7	277.7	2	1	04
4570	Reduce DHW Temperature	32	187	12	226.2	226.2	1	1	04
4668	Reset Heat Controls	120	701	49	211.8	211.8	4	1	02
4600	Reset Heat Controls	96	809	49	209.0	209.0	4	1	02
4101	Reduce DHW Temperature	49	201	12	200.9	200.9	1	1	36
4600	Reduce DHW Temperature	49	201	12	200.9	200.9	1	1	36
4573	Reset Heat Controls	97	562	49	169.8	169.8	4	1	02
4574	Reset Heat Controls	97	562	49	169.8	169.8	4	1	02
4667	Reduce DHW Temperature	22	126	12	151.8	151.8	1	1	04
4639	Reset Heat Controls	84	488	49	147.6	147.6	4	1	02
4125	Reduce DHW Temperature	28	115	12	115.7	115.7	1	1	36
4614	Stop Valve Packing Leak	11	96	12	99.4	99.4	1	1	06
4401	Reset Heat Controls	56	326	49	98.6	98.6	4	1	02
4402	Reset Heat Controls	56	326	49	98.6	98.6	4	1	02
4508	Add DHW Temp. Control	841	2,843	562	86.6	86.6	16	1	04

INCREMENT F (Cont'd)

OPERATION AND MAINTENANCE ECO SUMMARY

BLDG	CONSERVATION OPTION	MBTU/YR	$/YR	TOTAL COST	ESIR	SIR	MANHOURS	L.T.	REF.
4403	Reset Heat Controls	46	267	49	80.7	80.7	4	1	02
4405	Reset Heat Controls	46	267	49	80.7	80.7	4	1	02
4509	Add DHW Temp. Control	770	2,601	562	79.2	79.2	16	1	04
4644	Stop Pump Packing Leak	11	64	12	77.1	77.1	1	1	06
4502	Add DHW Temp. Control	531	1,796	562	54.7	54.7	16	1	04
4505	Add DHW Temp. Control	531	1,796	562	54.7	54.7	16	1	04
4517	Add DHW Temp. Control	522	1,763	562	53.7	53.7	16	1	04
4507	Add DHW Temp. Control	507	1,712	562	52.1	52.1	16	1	04
4506	Add DHW Temp. Control	470	1,587	562	48.3	48.3	16	1	04
4531	Add DHW Temp. Control	455	1,537	562	46.8	46.8	16	1	04
4530	Add DHW Temp. Control	455	1,537	562	46.8	46.8	16	1	04
4510	Add DHW Temp. Control	430	1,452	562	44.2	44.2	16	1	04
4503	Add DHW Temp. Control	418	1,414	562	43.0	43.0	16	1	04
4514	Add DHW Temp. Control	412	1,392	562	42.4	42.4	16	1	04
4560	Add DHW Temp. Control	251	1,462	562	38.4	38.4	16	1	04
4561	Add DHW Temp. Control	251	1,462	562	38.4	38.4	16	1	04
4562	Add DHW Temp. Control	251	1,462	562	38.4	38.4	16	1	04
4563	Add DHW Temp. Control	251	1,462	562	38.4	38.4	16	1	04
4649	Insulate 30 Ft HW Pipe	510	2,968	1,280	34.2	34.2	16	3	07
4519	Add DHW Temp. Control	286	966	562	29.4	29.4	16	1	04
4504	Add DHW Temp. Control	245	828	562	25.2	25.2	16	1	04
4520	Add DHW Temp. Control	235	793	562	24.2	24.2	16	1	04
4414	Install 4 Fan Dampers	70	405	366	16.3	16.3	10	1	01
4101	Reduce DHW Flow	45	182	147	15.2	15.2	6	1	35
4624	Replace Steam Trap	11	95	110	10.9	10.9	4	1	06
4611	Hall Lamp Timer	8	31	46	8.3	8.3	2	2	40
4624	Store Room Light Timer	7	28	46	7.5	7.5	2	2	40
4600	Timer On Vend. Machines	8	34	58	7.1	7.1	2	2	34
4537	Add Exhaust Fan Damper	7	59	110	6.8	6.8	4	1	01
4428	Add 1 Light Timer	3	11	22	6.3	6.3	2	2	40
4575	Laundry Light Timer	3	11	22	6.3	6.3	2	2	40
4576	Laundry Light Timer	3	11	22	6.3	6.3	2	2	40
4578	Laundry Light Timer	3	11	22	6.3	6.3	2	2	40
4614	Repair Radiator Valve	6	47	98	6.1	6.1	4	1	08
4525	Repair Vent Fan Dampers	9	73	171	5.4	5.4	4	1	01
4108	Replace 3 Vent Dampers	16	91	256	5.2	5.2	6	1	01
4548	Repair Vent Dampers	13	114	281	5.1	5.1	8	1	01
4618	Remove 26 Shades	14	55	131	5.1	5.1	12	2	37
4619	Remove 26 Shades	14	55	131	5.1	5.1	12	2	37
4618	Delamp 9 Fixtures	9	35	87	4.9	4.9	8	2	38
4619	Delamp 9 Fixtures	9	35	87	4.9	4.9	8	2	38
4413	Delamp 40W	2	8	22	4.6	4.6	2	2	38
4415	Add 2 Lt. Timers	8	34	93	4.5	4.5	4	2	40
4416	Add 2 Lt. Timers	8	34	93	4.5	4.5	4	2	40
4608	Bath Light Timers	17	68	185	4.5	4.5	8	2	40

INCREMENT F (Cont'd)

OPERATION AND MAINTENANCE ECO SUMMARY

BLDG	CONSERVATION OPTION	MBTU/YR	$/YR	TOTAL COST	ESIR	SIR	MANHOURS	L.T.	REF.
4611	Delamp 4 Fixtures	4	16	44	4.4	4.4	4	2	38
4406	Remove 10 Shades	6	24	66	4.4	4.4	6	2	37
4408	Delamp 40W	1	4	11	4.4	4.4	1	2	38
4612	Photocell Outdoor Lights	8	34	105	4.0	4.0	4	2	41
4428	Remove 15 Lamp Shades	6	24	87	3.3	3.3	8	2	37
4609	Remove Lamp Shades	6	24	87	3.3	3.3	8	2	37
4528	Delamp 800W	14	59	219	3.3	3.3	20	2	38
4611	Remove 10 Lamp Shades	3	12	44	3.3	3.3	4	2	37
4402	Add 1 Light Timer	3	11	46	3.0	3.0	2	2	40
4403	Add 1 Lt. Timer	3	11	46	3.0	3.0	2	2	40
4405	Add 1 Lt. Timer	3	11	46	3.0	3.0	2	2	40
4406	Add 1 Lt. Timer	3	11	46	3.0	3.0	2	2	40
4407	Add 2 Lt. Timers	6	23	93	3.0	3.0	4	2	40
4413	Add 1 Lt. Timer	3	11	46	3.0	3.0	2	2	40
4420	Add 1 Lt. Timer	3	11	46	3.0	3.0	2	2	40
4574	Laundry Light Timer	3	11	46	3.0	3.0	2	2	40
4606	Bath Light Timers	11	45	185	3.0	3.0	8	2	40
4607	Bath Light Timers	14	57	231	3.0	3.0	10	2	40
4101	Add 4 Light Switches	24	98	463	2.6	2.6	20	2	39
4667	Repair 5 Broken Windows	4	26	151	2.6	2.6	8	4	09
4625	Add Radiator Valves	11	89	440	2.6	2.6	12	1	08
4560	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4561	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4562	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4563	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4565	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4567	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4572	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4573	Laundry Light Timer	2	9	46	2.5	2.5	2	2	40
4606	Laundry Light Timers	5	19	93	2.5	2.5	4	2	40
4609	Laundry Light Timers	5	19	93	2.5	2.5	4	2	40
4544	Add 2 Vent Dampers	5	42	220	2.4	2.4	8	1	01
4540	Replace Radiator Valves	8	65	342	2.4	2.4	8	1	08
4538	Replace Radiator Valves	18	149	781	2.4	2.4	24	1	08
4548	Repair Broken Window	1	11	61	2.4	2.4	2	1	09
4525	Shut Off 4 Hall Radiators	4	35	195	2.3	2.3	8	1	08
4423	Add 1 Light Timer	2	8	46	2.2	2.2	2	2	40
4617	Bath Light Timers	9	38	210	2.2	2.2	8	2	40
4422	Remove 22 Shades	6	24	131	2.2	2.2	12	2	37
4190	Radiator Valves, 4	7	43	293	2.2	2.2	8	1	08
4410	Insulate Steam Valves	37	213	1,481	2.1	2.1	10	3	03
4111	Insulate Steam Valves	48	281	2,041	2.0	2.0	12	3	03
4408	Add 2 Lt. Timers	4	15	93	2.0	2.0	4	2	40
4422	Add 1 Light Timer	2	8	46	2.0	2.0	2	2	40
4427	Add 3 Light Timers	6	23	139	2.0	2.0	6	2	40

INCREMENT F (Cont'd)

OPERATION AND MAINTENANCE ECO SUMMARY

BLDG	CONSERVATION OPTION	MBTU/YR	$/YR	TOTAL COST	ESIR	SIR	MANHOURS	L.T.	REF.
4609	Bath Light Timers	6	23	139	2.0	2.0	6	2	40
4615	Bath Light Timers	7	30	185	2.0	2.0	8	2	40
4618	Bath Light Timers	7	30	185	2.0	2.0	8	2	40
4619	Bath Lamp Timers	7	30	185	2.0	2.0	8	2	40
4601	Remove 40 Lamp Shades	10	41	262	1.9	1.9	24	2	37
4101	Remove 108 Lt. Shades	19	79	547	1.8	1.8	50	2	37
4106	Remove 20 Lt. Shades	4	16	109	1.8	1.8	10	2	37
4424	Add 2 Light Timers	3	13	93	1.7	1.7	4	2	40
4565	Insulate HTW Valves	14	81	691	1.7	1.7	6	3	03
4567	Insulate HTW Valves	14	81	691	1.7	1.7	6	3	03
4568	Insulate HTW Valves	14	81	691	1.7	1.7	6	3	03
4644	Insulate Valves	27	154	1,480	1.5	1.5	10	4	03
4426	Add 1 Light Timer	1	6	46	1.5	1.5	2	2	40
4125	Add 3 Lt. Switches	10	39	358	1.3	1.3	16	2	39
4136	Add 3 Light Switches	10	39	358	1.3	1.3	16	2	39
4600	Repair Bath. Rad. Valves	2	15	147	1.3	1.3	8	1	08
4425	Add 2 Light Timers	2	9	93	1.2	1.2	4	2	40
4528	Add Light Switch	4	15	149	1.2	1.2	8	2	39
4437	Seal Bldg. Envelope Holes	2	19	241	1.0	1.0	16	4	09
4402	Add 1 Light Switch	3	12	149	1.0	1.0	8	2	39
4525	Repair Freezer Door Seals	1	6	106	.7	.7	4	4	43
4538	Repair Freezer Door	1	5	106	.6	.6	4	4	43
4528	Repair Freezer Door	1	6	151	.5	.5	8	4	43
4546	Repair Refrigerator Door	1	6	167	.4	.4	4	4	43
4419	Add 1 Photocell	1	3	105	.3	.3	4	2	41
4638	Repair Freezer Doors	1	5	212	.3	.3	8	4	43
4418	Add 2 Photocells	1	3	210	.2	.2	8	2	41

5.0 SPECIAL APPROACHES TO ENERGY UTILIZATION

Part of the EEA effort was directed toward special approaches to energy utilization with the goal of reducing dependency on critical fuels as well as well as reducing energy consumption. Renewable energy sources including solar, biomass, geothermal, wind and waste have general potential to replace petroleum and natural gas as fuels for space heating and hot water. For the current Husterhoeh Kaserne applications waste-to-energy, geothermal and solar appeared to be technically feasible renewable energy sources. Other special approaches which have been successfully applied elsewhere were analyzed but found inappropriate for the specific application factors at Husterhoeh Kaserne.

The conclusions of the various energy utilization approaches evaluated are summarized below:

Opportunity Investigated	Conclusion
Utilization of Wind Energy	Average wind velocities in are too low for practical applications.
Geothermal Energy	Geological conditions in this area lend themselves to probable application for a geothermal/heat pump system; however, sufficient data on geothermal deposits is unavailable.
Biomass (Fuel Derived from Plant Life)	This technology is not commercially developed and the availability of fuel stock is unreliable.
Waste-to-Energy Systems - Refuse Derived Fuel	There is no network in Husterhoeh Kaserne which has a sufficient base load for burning the refuse collected. Therefore, in light of the high investment costs, it is not possible to operate the facility for sufficient hours per year to make it economical.

Opportunity Investigated	Conclusion
Waste-to-Energy Systems (Cont'd)	
- Biogas	Biogas is not competitive with fossil fuels and does not have a potential for utilization in Husterhoeh Kaserne.
- Sewage Gas	Cost effective utilization of sewage gas is not possible. If new sewage plants are constructed or major renovations made for other purposes, the utilization of sewage gas appears attractive.
- Pyrolysis of Municipal Refuse	This technology has not advanced far enough to be considered for commercial development.
Coal/Oil Mixtures	This technology is being developed for commercial demonstration. This fuel is not now available for commercial purchase.
Solar Energy	The most appropriate application of this proven technology is for heating domestic water. Analysis concluded that this application was not life cycle cost effective by ECIP criteria for nine buildings having the greatest application potential.
District Heating	Utilization of municipal district heating is very common in West Germany but no systems are located in the vicinity of Husterhoeh Kaserne; however, studies are being conducted by the municipality as to the feasibility of constructing a waste-burning facility and district heating network.

EMCS applications studied for the Husterhoeh Kaserne resulted in the recommendation of localized EMCS in the form of building heating system controls (MICRO Systems) and remote limited function EMCS for peak demand limiting. The heating system controls bring significant energy savings to be incorporated in the ECIP projects. The demand limiting EMCS reduces utility charges but does not significantly save energy; this project must be funded through sources other than ECIP.

6.0 ENERGY PLAN

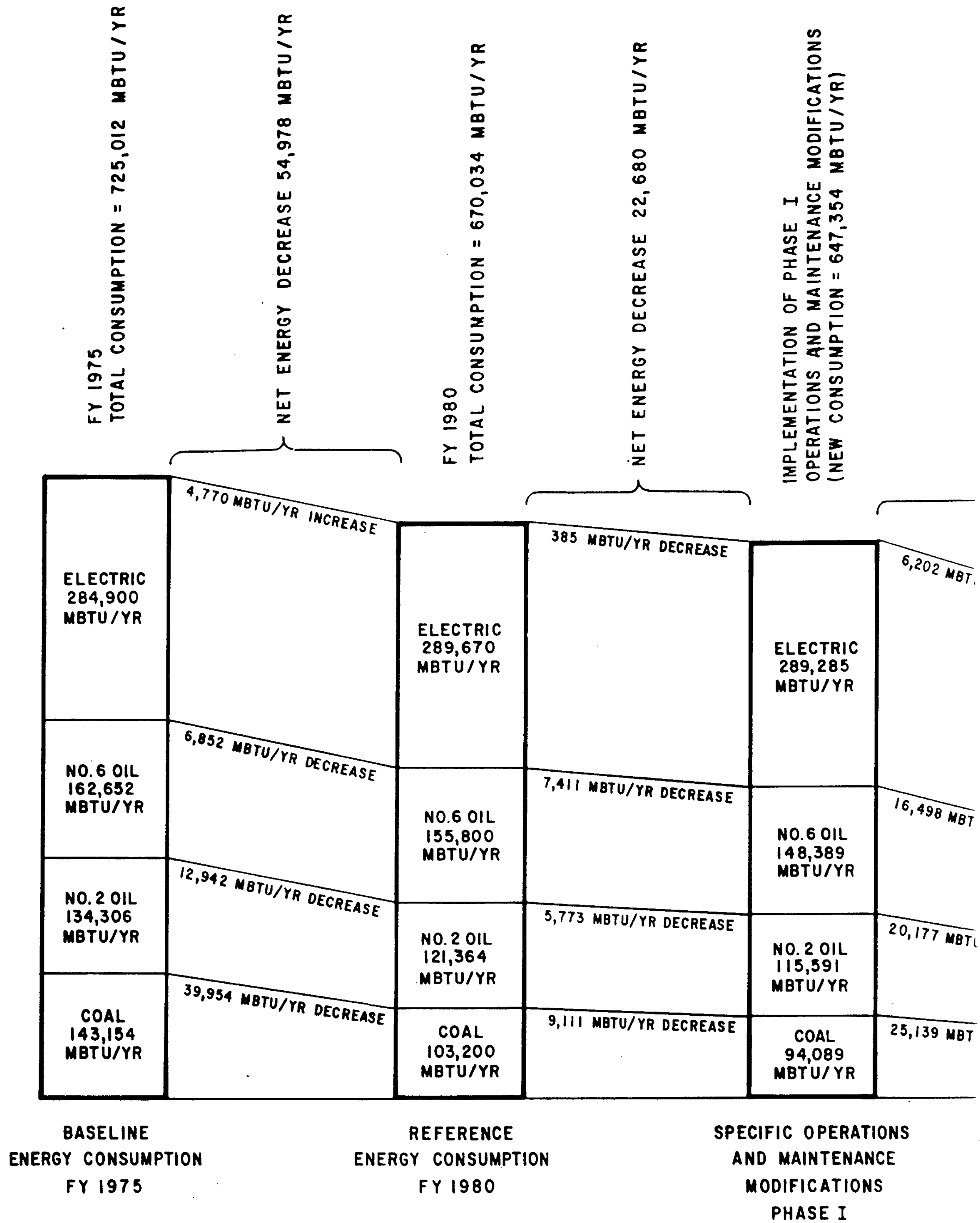
The "Basewide Energy Plan" as developed hereunder integrates ongoing energy conservation operations and maintenance activities, programmed ECIP Projects, programmed projects (which save energy) in the OMA, MMCA, MCA and FH categories and EEAP Study recommendations in both the operations and maintenance category and the capital (ECIP) improvement category.

Figure 6.1 graphically depicts the implementation of the following energy plan. Figure 6.2 shows the energy consumption/energy savings profile as a function of time. The baseline data is as follows:

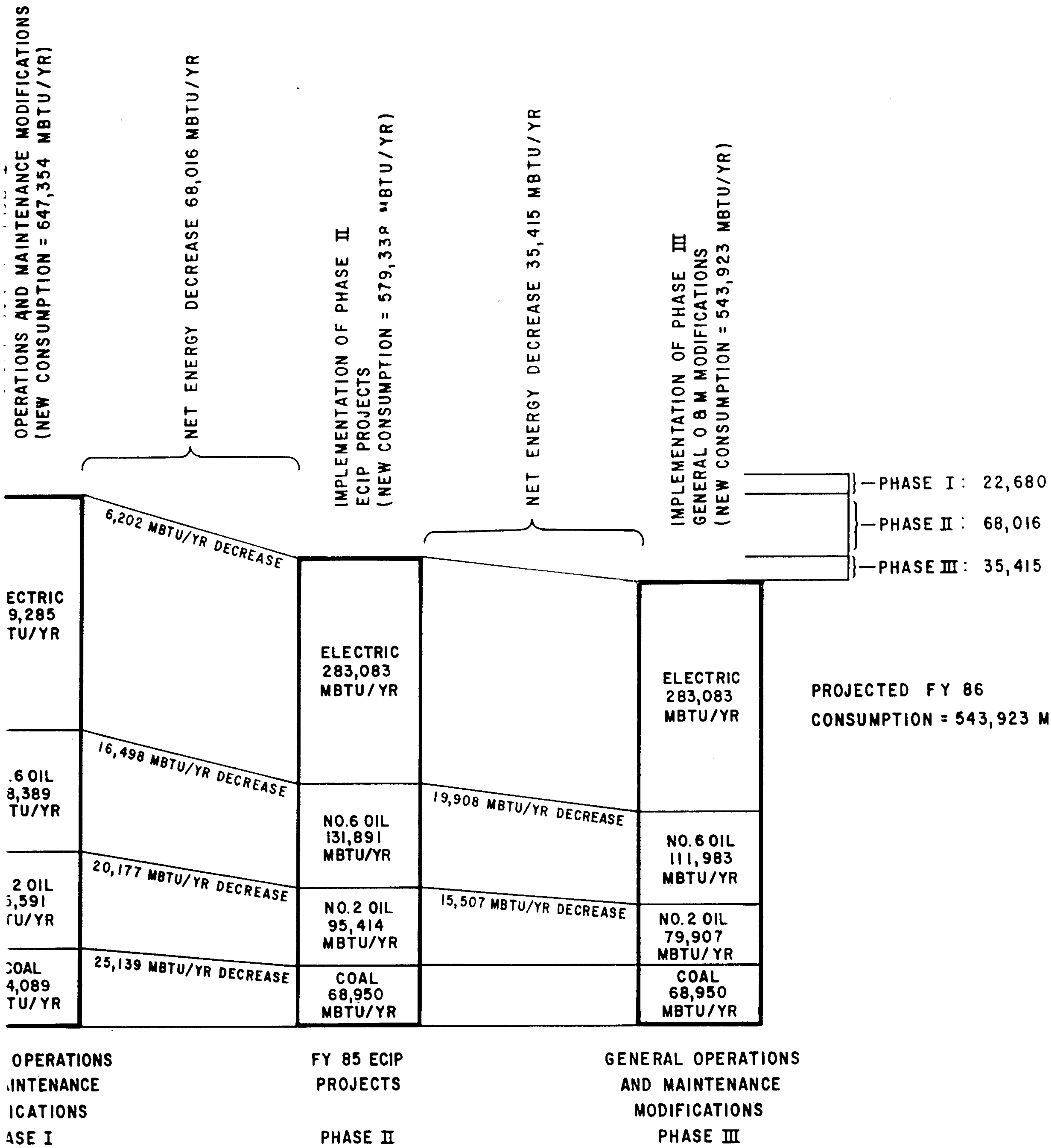
FY 75 BASELINE ENERGY CONSUMPTION	: 725,012 MBTU/YR
CRITICAL FUEL OIL CONSUMPTION	: 296,958 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 219.57

The reference year for this study is FY 80. The available data indicates that community energy conservation activities were able to effectively reduce total energy consumption as follows:

FY 80 REFERENCE ENERGY CONSUMPTION	: 670,034 MBTU/YR
% REDUCTION FROM BASELINE	: 7.6%
FY 80 CRITICAL FUEL OIL CONSUMPTION	: 277,164 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 202.9


FY 1975
TOTAL CONSUMPTION = 725,012 MBTU/YR
NET ENERGY DECREASE 54,978 MBTU/YR
FY 1980
TOTAL CONSUMPTION = 670,034 MBTU/YR
NET ENERGY DECREASE 22,680 MBTU/YR
IMPLEMENTATION OF PHASE I
OPERATIONS AND MAINTENANCE MODIFICATIONS
(NEW CONSUMPTION = 647,354 MBTU/YR)
ELECTRIC 284,900 MBTU/YR
NO. 6 OIL 162,652 MBTU/YR
NO. 2 OIL 134,306 MBTU/YR
COAL 143,154 MBTU/YR
4,770 MBTU/YR INCREASE
6,852 MBTU/YR DECREASE
12,942 MBTU/YR DECREASE
39,954 MBTU/YR DECREASE
ELECTRIC 289,670 MBTU/YR
NO. 6 OIL 155,800 MBTU/YR
NO. 2 OIL 121,364 MBTU/YR
COAL 103,200 MBTU/YR
385 MBTU/YR DECREASE
7,411 MBTU/YR DECREASE
5,773 MBTU/YR DECREASE
9,111 MBTU/YR DECREASE
ELECTRIC 289,285 MBTU/YR
NO. 6 OIL 148,389 MBTU/YR
NO. 2 OIL 115,591 MBTU/YR
COAL 94,089 MBTU/YR
6,202 MBT
16,498 MBT
20,177 MBT
25,139 MBT
BASELINE ENERGY CONSUMPTION FY 1975
REFERENCE ENERGY CONSUMPTION FY 1980
SPECIFIC OPERATIONS AND MAINTENANCE MODIFICATIONS PHASE I

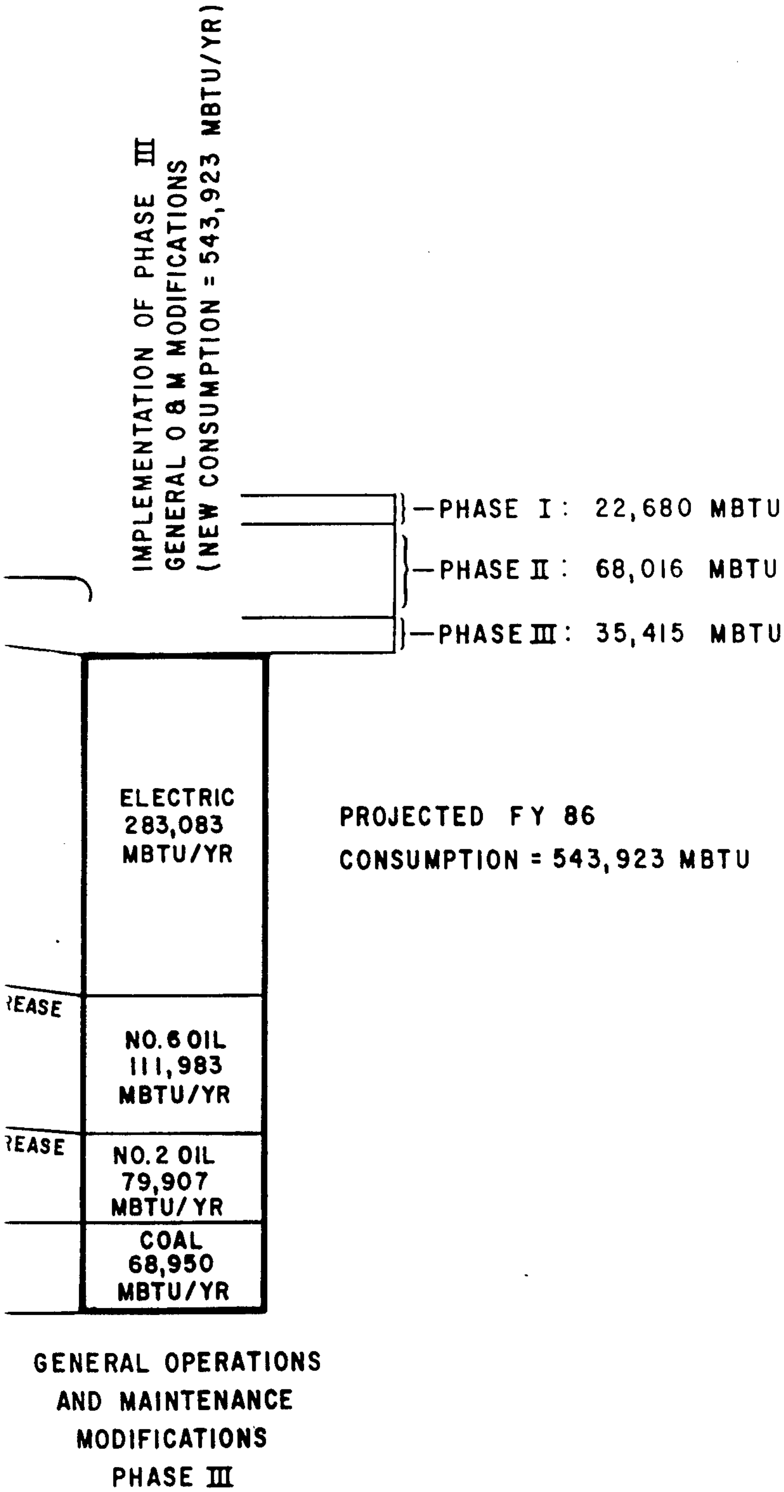
1



EEAP ENERGY P

FIGURE 6

2



EEAP ENERGY PLAN

FIGURE 6. 1

3

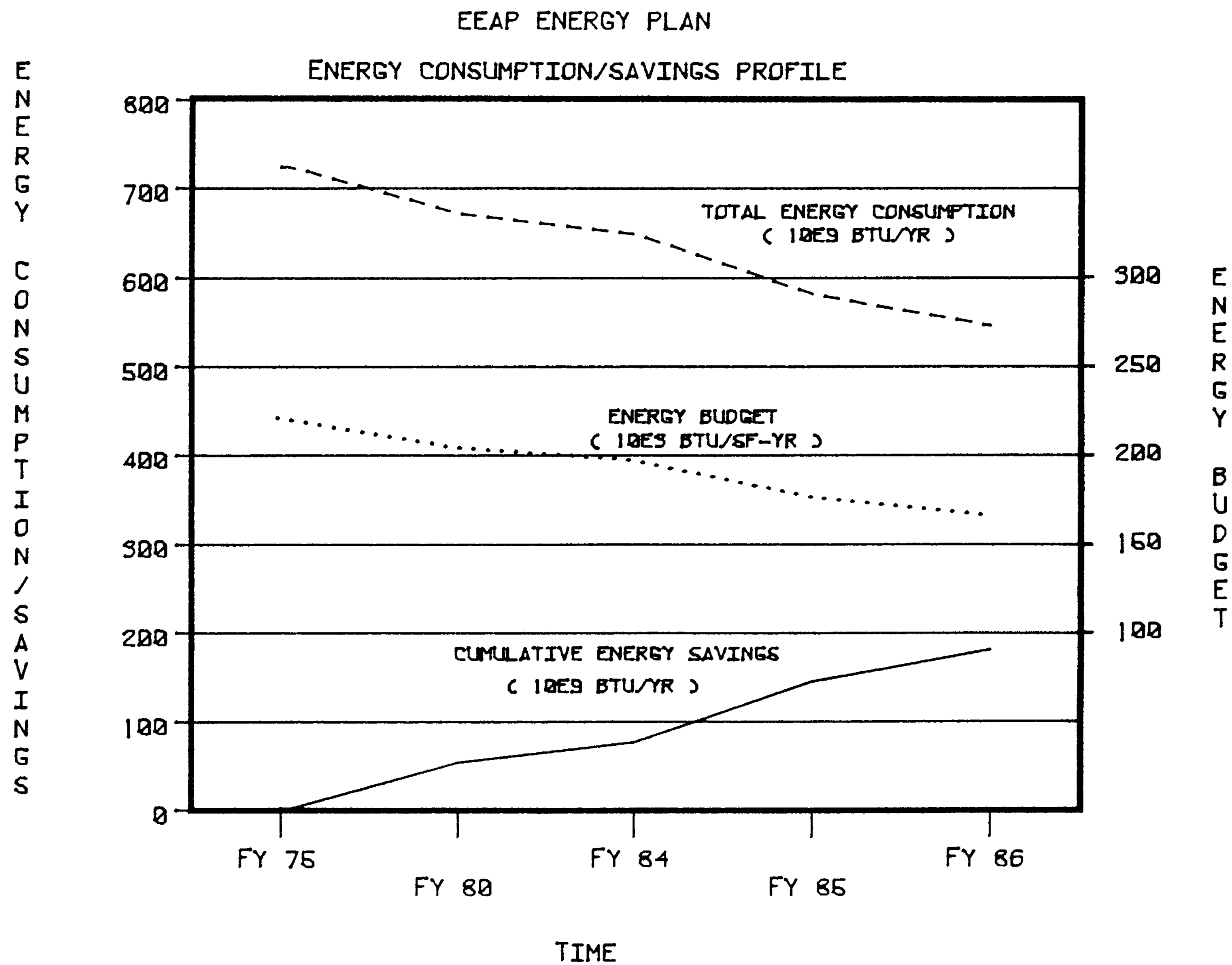

EEAP ENERGY PLAN
ENERGY CONSUMPTION/SAVINGS PROFILE
ENERGY CONSUMPTION/SAVINGS
800
700
600
500
400
300
200
100
0
ENERGY BUDGET
300
250
200
150
100
TOTAL ENERGY CONSUMPTION
(10E9 BTU/YR)
ENERGY BUDGET
(10E3 BTU/SF-YR)
CUMULATIVE ENERGY SAVINGS
(10E9 BTU/YR)
FY 75
FY 80
FY 84
FY 85
FY 86
TIME

FIGURE 6.2

Phase I of the energy plan is the implementation of specific operations and maintenance type modifications (para. 4.2). Using in-house labor these modifications can be made relatively quickly and can be done inexpensively; collectively, they will yield a payback of less than two months and reduce the total annual energy consumption as follows:

Upon Completion of Phase I:

TOTAL ENERGY CONSUMPTION	: 647,354 MBTU/YR
% REDUCTION (CUMULATIVE) FROM BASELINE	: 10.7%
CRITICAL FUEL OIL CONSUMPTION	: 263,980 MBTU/YR
ENERGY BUDGET KBTU/SF - YR (10^3)	: 196.0

Phase II of the energy plan is in part, the ongoing energy conservation efforts of Husterhoeh Kaserne. The anticipated savings for this phase are derived from those projects which have already been programmed by the community and are in various stages of approval, design or construction. Community energy savings projections are unavailable.

Phase II also includes the implementation of energy conservation measures recommended herein (para. 4.1) and chosen by the community for implementation. Project documentation has already been developed for Phase II projects and been sent forward for approval for FY 85 funding. The savings projection for this phase is 68,016 MBTU/yr. The reduction of total annual energy consumption is as follows:

Upon Completion of Phase II :

TOTAL ENERGY CONSUMPTION	: 579,338 MBTU/YR
% REDUCTION (CUMULATIVE) FROM BASELINE	: 20.1%
CRITICAL FUEL OIL CONSUMPTION	: 227,305 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 175.5

Phase III of the energy plan is the implementation of general operations and maintenance type measures. Most of these measures have not been quantified because they are either accomplished during the normal course of maintenance, are maintenance activities necessary to maintain level of savings achieved through other energy savings measures or are monitoring activities which are necessary in order to achieve success in any energy conservation plan. These general operations and maintenance type measures are discussed in Sections 6.3 and 6.4. The savings projection for this phase is 35,415 MBTU/yr. The reduction of total annual energy consumption is as follows:

Upon Completion of Phase III:

TOTAL ENERGY CONSUMPTION	: 543,923 MBTU/YR
% REDUCTION (CUMULATIVE) FROM BASELINE	: 25%
CRITICAL FUEL OIL CONSUMPTION	: 191,890 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 164.7

Implementation of this energy conservation plan will result in several coincident energy reductions on the same buildings. Care was taken so as not to duplicate energy savings within the secondary systems or between the primary and secondary systems; therefore, in view of the conservative approach taken in energy savings calculations, the predicted savings are achievable. However, a program for monitoring the progress of the energy plan and gauging the savings is of the utmost importance; this is necessary to identify problems in meeting goals as early on in the program as is feasible.

Figure 6.3 presents a matrix of the energy conservation projects versus savings and costs.

6.1 Army Facilities Energy Plan Goals

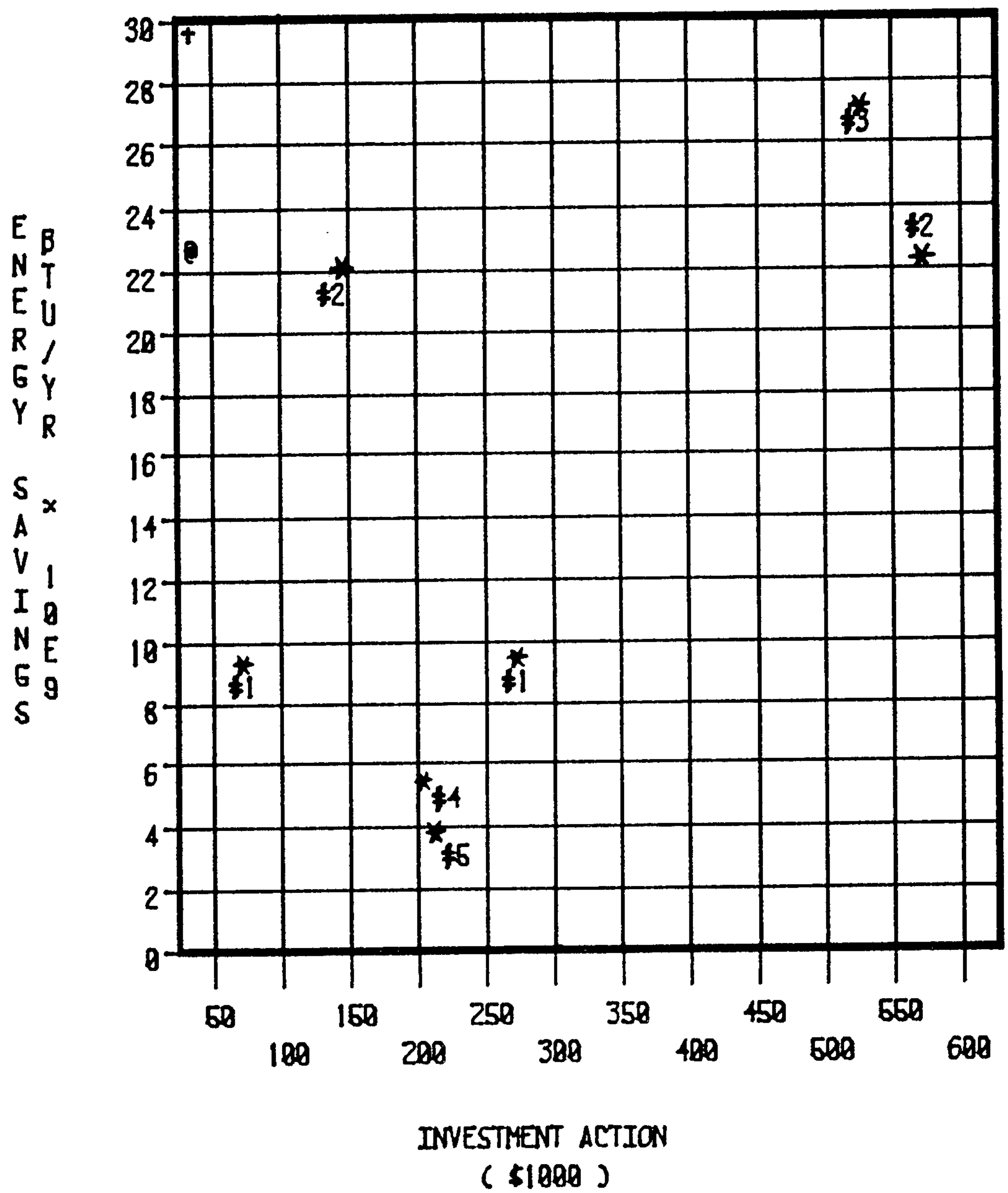
The above described plan was developed to reduce energy consumption at Husterhoeh Kaserne in accordance with the goals of the Army Facilities Energy Plan.

A comparison of the goals of the Army Facilities Energy Plan and the findings and results of this study is made in Table 6.4.

FIGURE 6.3

ACTION-SAVINGS MATRIX

EEAP ENERGY PLAN



LEGEND

@ - SPECIFIC OPERATIONS AND MAINTENANCE ECO'S (SIR>100)

* - ECIP DD FORM 1391: #1- ECIP WEATHERIZATION
#2- ECIP ENERGY CONSERVATION IMPROVEMENTS
#3- ECIP FAM. HSG. ENERGY CONSERVATION IMPROVEMENTS
#4- ECIP FACILITIES ENERGY IMPROVEMENTS
#5- ECIP HEAT RECOVERY SYSTEMS

+ - GENERAL OPERATIONS AND MAINTENANCE ECO'S (SIR>100)

TABLE 6.4

YEAR 1985 GOALS	ARMY FACILITIES ENERGY PLAN	EEAP ENERGY PLAN
	a. Reduce Army installation and activity energy consumption by 25% of that consumed in FY 75 as the base year.	a. Energy consumption reductions to date in combination with recommended operations and maintenance modifications and recommended ECIP projects will serve to reduce annual consumption by approximately 25%.
	b. Reduce average annual energy consumption per gross square foot of floor area by 20% in existing facilities compared to FY 75 as the base year. At least 12% of the energy reduction in existing buildings shall be accomplished through energy conservation projects under the Energy Conservation Investment Program (ECIP).	b. The average annual energy consumption will be reduced from 219,570 BTU/SF - YR to 164,700 BTU/SF - YR upon complete implementation of the plan; this is a 25% reduction. The EEAP ECIP projects will save an estimated 9.4% of FY 75 consumption of existing facilities; this coupled with community-programmed ECIP projects should meet the goal.
	c. Reduced average annual energy consumption per gross square foot of floor area by 45% in new buildings compared to FY 75 as the base year.	c. This shall be accomplished by proper review and monitoring throughout the design phase.
	d. Reduce dependence on critical fuels:	d.
	1. Obtain at least 10% of total Army installation energy from coal, coal gasification, solid waste, refuse derived fuel and biomass.	1. Over 15% of the existing facilities are currently heated by coal.
	2. Equip all natural gas only heating units and plants over 5 MEGA BTU per hour output with the capability to use oil or other alternate fuels.	2. Husterhoeh Kaserne does not have any natural gas only heating units over 5 MEGA BTU.
	3. To have on hand at the beginning of each heating season a 30-day fuel supply for all oil only, oil - natural gas, and coal heating units over 5 MEGA BTU per hour output based upon the coldest month recorded and in a mobilization condition.	3. This shall be accomplished through implementation of proper procurement regulations.
	4. Obtain 1% of total Army installation energy by solar means.	4. Based on analysis of solar applications for Husterhoeh Kaserne area, solar energy projects should be concentrated in other geographical areas where the project economics are expected to be very attractive.
	5. Restrict the use of electric resistance heating to those applications prescribed in ETL 1110-3-254.	5. Survey data did not indicate that electric resistance heating was being used in Husterhoeh Kaserne. In communities where building heating control systems had been installed, use of portable electric heaters in barracks and family housing was reported. This illustrates the need to institute tight controls over unauthorized use of private electric resistance heaters.
	6. Require the energy efficiency ratios of new windows air conditioning units to be 8.5 or greater for 120 volt units and 8.0 or greater for 230 volt units.	6. Air conditioning units are not generally installed at Husterhoeh Kaserne. Recommendations for purchase of energy conservation design options on replacement equipment are included in Section 6 of Volume II.

TABLE 6.4 (CONT'D)

	ARMY FACILITIES ENERGY PLAN	EEAP ENERGY PLAN
YEAR 2000 GOALS	a. Reduce Army installation and activity energy consumption by 50% of that consumed in FY 75.	a. This goal, although difficult to attain, is within reach. By implementing the EEAP Plan, the existing structures and utility systems will have been modified with those conservation measures now practical; this will reduce FY 75 energy consumption by almost 25%. Through proper maintenance, these savings should be maintained through 2000. The additional savings will be achieved by the construction of new more efficient facilities, replacement of inefficient equipment through attrition and general maintenance and operations measures (not quantified) discussed in Volume II; as fuel oil prices escalate many new projects will become economically viable.
	b. Reduce dependence on critical fuels. 1. Eliminate use of natural gas. 2. Reduce the use of petroleum fuels in installations operations by 75%.	b. These goals can be met through conventional technology. The EEAP Plan shows a reduction of 35% in critical fuels. The most logical approach to further reduction in critical fuels would be repair by replacement of oil-fired heating plants (oil to coal conversion).